

June 2003

# **Economic Analysis of Management Alternatives for Personal Watercraft in Chickasaw National Recreation Area**

## **Revised Final Report**

Prepared for

**Dr. Bruce Peacock  
National Park Service  
Environmental Quality Division**

Prepared by

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\*RTI International is a trade name of Research Triangle Institute.

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# 1

## Introduction

Historically, NPS classified PWC with other water vessels, which allowed their use when the use of other vessels was permitted. More recently, NPS has reevaluated its methods of PWC regulation. This report describes the results of an economic analysis of the proposed alternatives for regulating PWC use in Chickasaw National Recreation Area (CHIC).

Historically, the National Park Service (NPS) classified personal watercraft (PWC) with all other water vessels, which allowed people to use PWC when the use of other vessels was permitted by a Superintendent's Compendium.<sup>1</sup> In recognition of its duties under the Organic Act and NPS Management Policies, as well as increased awareness and public controversy, NPS reevaluated its methods of PWC regulation. Because of new information regarding potential resource impacts, conflicts with other users, and safety concerns associated with PWC use, NPS proposed a PWC-specific regulation in 1998. The regulation stipulated that PWC would be prohibited in units of the national park system unless NPS determines that PWC use is appropriate for a specific unit based on that unit's enabling legislation, resources and values, other visitor uses, and overall management objectives (63 FR 49,312–17, September 15, 1998). This report describes the results of an economic analysis of the proposed alternatives for regulating PWC use in Chickasaw National Recreation Area (CHIC), which is located just south of Sulphur, OK.

During a 60-day comment period, NPS received nearly 20,000 comments on this proposed regulation. As a result of public comments and further review, NPS promulgated an amended regulation in March 2000 allowing NPS to permit PWC use in 11 units by promulgating a special regulation and in an additional 10 units by amending the Superintendent's Compendiums (36 CFR

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<sup>1</sup>A compendium is an NPS management tool used specifically by a park superintendent to take actions to address park-specific resource protection concerns.

3.24[b], 2000). The March 2000 regulation provided park units a 2-year grace period in which PWC use could continue after which time PWC would be banned from any park that took no action to promulgate either PWC-specific regulations or to regulate PWC use in the Superintendent's Compendium.

On August 31, 2000, Bluewater Network et al. filed a complaint with the United States District Court for the District of Columbia against NPS alleging, among other things, that the NPS rule-making decisions to allow PWC use in some park units after 2002 by making entries in Superintendent's Compendiums would not provide the opportunity for public input. In addition, the environmental group claimed that because PWC cause water and air pollution, generate noise, and pose public safety threats, NPS acted arbitrarily and capriciously when making its September 1998 and March 2000 decisions.

A settlement agreement between NPS and Bluewater Network was signed by the District Court on April 12, 2001. The agreement requires all park units wishing to continue PWC use to promulgate special regulations only after each unit conducts environmental analysis in accordance with the 1969 National Environmental Policy Act (NEPA). At minimum, the NEPA analysis must evaluate the impacts of PWC on water quality, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety. In addition, NPS is required by federal statutes, including Executive Order 12866, to conduct a benefit-cost analysis of the proposed regulation and analyze the impact of the regulation on small businesses under the Regulatory Flexibility Act (RFA) of 1980. Based on this settlement, PWC use in CHIC was to be prohibited after September 15, 2002 if a final rule permitting their use was not promulgated. However, a stipulated modification to this settlement agreement was approved by the court on September 9, 2002 that permitted PWC use in CHIC until November 6, 2002. After that date, PWC use in CHIC is prohibited until the final rule is published.<sup>2</sup> This report describes the results of an economic analysis of the proposed alternatives for regulating PWC use in CHIC, as required by the terms of the April 2001 settlement and by applicable federal statutes.

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<sup>2</sup> Under the no-action alternative, PWC use would continue to be banned.

## 1.1 ORGANIZATION OF REPORT

This report presents the NPS' economic analysis of the alternative CHIC PWC regulations under consideration. The report is organized as follows. Section 1 describes the reason for the regulation and the current and proposed regulations at CHIC. Baseline visitation, environmental conditions, and economic activity in CHIC are described in Section 2. The local economic impacts on the region surrounding CHIC are summarized in Section 3. Section 4 describes the methodology for assessing the impacts of the alternatives on social welfare and presents a cost-benefit analysis of the regulatory alternatives. Section 5 provides an analysis of the regulatory alternatives' impacts on small businesses. Uncertainties are addressed in Section 2 for visitation, Section 3 for regional economic impacts, and Section 5 for alternatives' impacts on businesses. In addition, Appendix A describes the principles of economic impact analysis and Appendix B includes a detailed theoretical discussion of the types of benefits and costs associated with PWC restrictions in national parks and the methods used in their measurement.

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## 1.2 PROBLEM ADDRESSED BY REGULATION

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*In general, regulations should be imposed only where a market failure exists that cannot be resolved efficiently by measures other than federal regulation.*

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The U.S. Office of Management and Budget (OMB) directs regulatory agencies to demonstrate the need for their rules (OMB, 1992). In general, regulations should be imposed only where a market failure exists that cannot be resolved efficiently by measures other than federal regulation. If each producer and consumer has complete information on his or her actions and makes decisions based on the full costs of those actions, resources will be allocated in a socially efficient manner. However, when the market's allocation of resources diverges from socially optimal values, a market failure exists. A defining feature of a market failure is the inequality between the social consequences of an action and a purely private perception of benefits and costs. The major causes of market failure identified in the OMB guidance on Executive Order 12866 are externalities, natural monopolies, market power, and inadequate or asymmetric information. For environmental problems resulting from market failures, this divergence between private and social perspectives is normally referred to as an externality. Such divergences occur when the actions of one economic entity impose

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*The justification for restricting PWC use in national parks is based on externalities associated with their use.*

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costs on parties that are external to, or not accounted for in, a market transaction or activity.

The justification for restricting PWC use in national parks is based on externalities associated with their use. For instance, the operation of PWC imposes costs on society associated with noise emissions, air and water pollution emissions, and health and safety risks. Because PWC users have little incentive to consider these external costs, they are likely to make decisions about PWC use without taking these impacts on other people into account.

If these externalities are internalized to the PWC users generating them, the problem can be mitigated. For example, if PWC users were required to pay for the marginal external costs they impose on others, they would begin to take those costs into account when making decisions and the market failure would be corrected. However, accurately assigning costs associated with each individual PWC user's actions and enforcing payment is essentially not feasible at this time. Other regulatory options to address the externalities associated with PWC use are far easier to implement and enforce. Some of these options include restricting areas where they are permitted, the time of day when they can be used, and PWC engine type.

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*The extent to which social welfare improves due to PWC regulation depends on the relative costs and benefits associated with such restrictions. While non-PWC users gain from PWC restrictions, the PWC users and local businesses that serve them experience welfare losses.*

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The extent to which social welfare improves due to PWC regulation depends on the relative costs and benefits associated with such restrictions. While non-PWC users gain from PWC restrictions, the PWC users and local businesses that serve them experience welfare losses. Thus, the likelihood that a particular regulatory option will improve social welfare in an individual national park unit is dependent on numerous park-specific factors that influence the level of costs and benefits. While a given set of restrictions on PWC use in one park may improve social welfare, the same set of restrictions in another park could easily have negative impacts on social welfare. For example, banning PWC in a park where there is little other motorized boating activity may result in large proportionate reductions in noise and emissions whereas banning PWC in a park with a high level of other motorized boating activity may not have a noticeable effect on noise or emissions levels. In the latter case, the costs to PWC users could be larger than the gains to other park visitors. Thus, it is important to consider the

conditions specific to each individual park in selecting the preferred regulatory alternative for that park.

### 1.3 CURRENT PWC ACTIVITIES AT CHIC

PWC use in CHIC (including operating, transiting, launching, and beaching) is currently prohibited as a result of an administrative determination made by CHIC on November 7, 2002. For the purposes of the analyses provided herein, a ban on PWC use within CHIC is considered the baseline condition. In accordance with the September 9, 2002, stipulated modification to the April 2001 settlement agreement, PWC use in CHIC is prohibited unless a final rule authorizing its use is promulgated. A map of CHIC identifying the national park boundary is presented in Figure 1-1.

### 1.4 PROPOSED REGULATIONS

The following four alternatives are being considered for the management of PWC in CHIC:

#### **Proposed Regulations for PWC Use in CHIC**

**Alternative A:** Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation

**Alternative B:** Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation But With Additional Management Restrictions

**Alternative C:** Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation, But Limit Use Areas

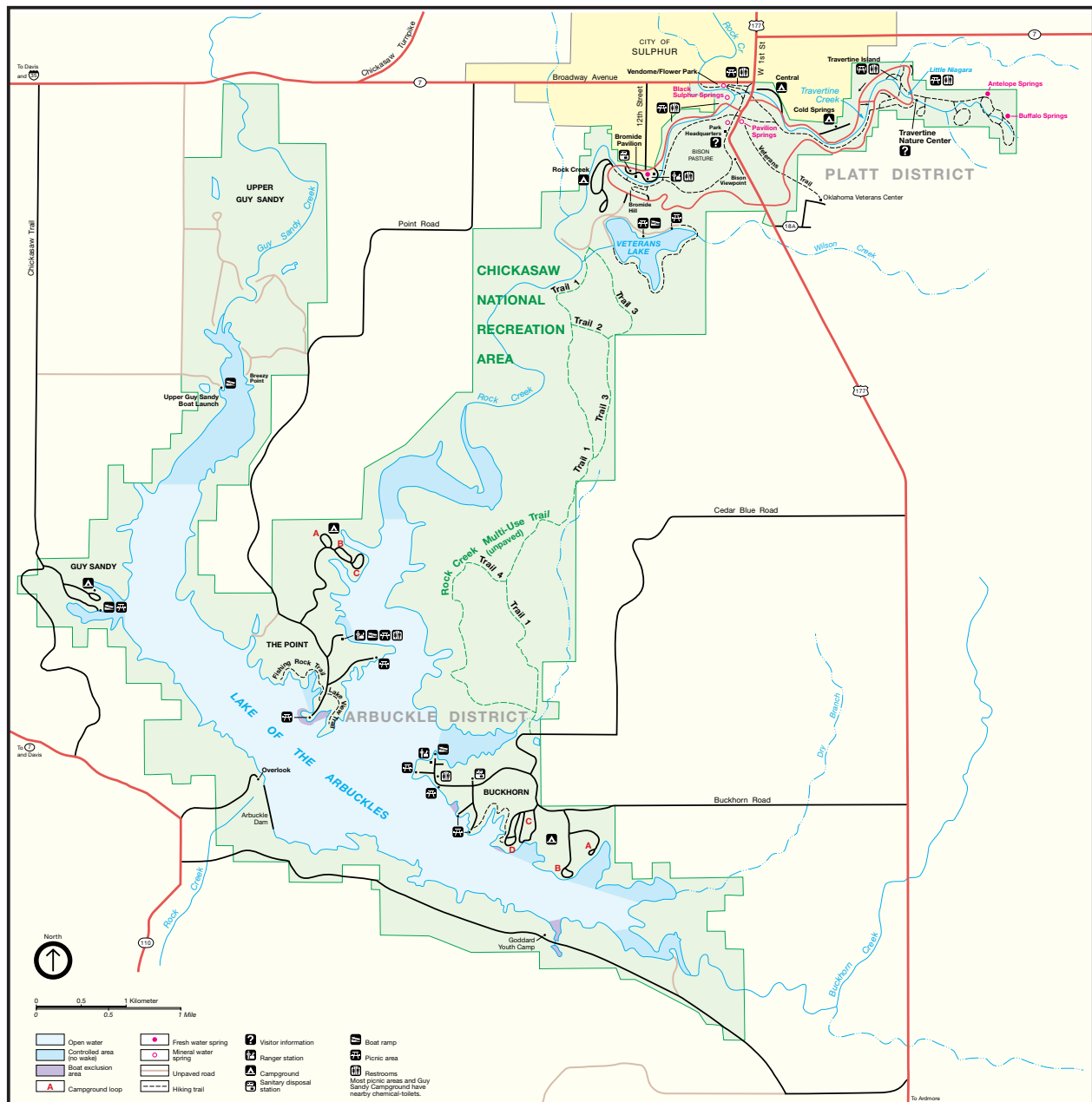
**Alternative D:** No-Action Alternative (Continue PWC Ban)

#### **Alternative A: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation**

Through November 6, 2002, PWC use was authorized in a Lake of the Arbuckles as described in the 2000 Superintendent's Compendium. Under this alternative, a special regulation would reinstate PWC use as it was previously permitted in the Superintendent's Compendium, and according to all relevant Oklahoma regulations. The provisions of the regulation would include the following:

- PWC can operate in Lake of the Arbuckles under existing boating regulations. These regulations include four boat exclusion areas in the vicinity of park campgrounds and picnic areas, and no-wake zones in many of the lake arms.
- All lakes of 100 acres or less are closed to PWC.
- All vessels, including PWC, shall not be operated at a speed greater than 5 mph or a no wake speed in the following locations: anywhere posted "No Wake" buoys are present; on Lake of the Arbuckles within the confines of Guy Sandy Harbor as defined by the breakwaters; and within 150 feet of all docks, launch ramps, boats at anchor, boats from which people are fishing, and shoreline areas near campgrounds.
- PWC may launch from Buckhorn, The Point, Guy Sandy, and Upper Guy Sandy (state boat ramp).

**Figure 1-1. Map of Chickasaw National Recreation Area**



- Enforce the Oklahoma State regulations relating to PWC use, as summarized in Table 1-1.

**Table 1-1. Oklahoma State Regulations Applicable to PWC**

Category	Regulation
Time of operation	<ul style="list-style-type: none"> <li>➤ Personal watercraft are not allowed to operate from sunset to sunrise.</li> </ul>
Operating restrictions	<ul style="list-style-type: none"> <li>➤ Children younger than 12 are not allowed to operate personal watercraft by themselves in park waters.</li> <li>➤ Personal watercraft cannot be operated at a speed that exceeds the established speed limits.</li> <li>➤ Personal watercraft may not be operated within 50 feet of another vessel while traveling at 10 mph or faster.</li> <li>➤ Towing a water-ski is prohibited unless a cutoff switch is installed.</li> <li>➤ Personal watercraft must have an observer in addition to the operator, or wide-angle mirrors for use by operator to see the person being towed.</li> <li>➤ PWC users cannot operate in a reckless or negligent manner that endangers life or property.</li> <li>➤ Operating a vessel under the influence of drugs or alcohol is prohibited.</li> </ul>
Safety	<ul style="list-style-type: none"> <li>➤ Personal floatation devices (PFD) are mandatory for all PWC riders.</li> <li>➤ Use of a cutoff, if installed by the manufacturer, is required.</li> </ul>

Source: National Park Service (NPS). 2003. *Chickasaw National Recreation Area Personal Watercraft Use Environmental Assessment*. Washington, DC: National Park Service.

**Alternative B: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation, But With Additional Management Restrictions (Preferred Alternative)**

Under Alternative B, a special regulation would allow PWC use at CHIC. Alternative B is the same as Alternative A except for the following additional management restrictions:

- Monitoring for presence of threatened or endangered species and at cultural resources sites; seasonal or permanent closures as needed for resource protection.
- PWC would be required to have state boater registration cards/other PWC information prior to operating in Lake of the Arbuckles.
- PWC must be fueled while trailered and/or away from the water surface.
- Extending the no-wake zone around the Buckhorn developed area from the existing launch ramp cove to the Buckhorn C Loop Cove in a 150-foot buffer along the shoreline, with PWC use allowed subject to additional restrictions in the presence of swimmers.

- Monitor PWC numbers/establish carrying capacity to determine if PWC impacts to air and water quality exceed a minor to moderate adverse effect.
- Additional programs/restrictions including: operators 12 years old or younger must be accompanied by an adult; establishment of a voluntary, self-regulatory PWC user group; establishment of a monitoring program to measure resource changes and impacts as a result of PWC use; increasing user fees; consultations with Native American tribes and local businesses to mitigate any potential effects of PWC regulation and use changes; and establishment of a voluntary user education program.

***Alternative C: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation, But Limit Use Areas***

Under Alternative C, a special regulation would allow PWC use in some areas of CHIC. Alternative C is the same as Alternative B except for the following additional restrictions:

- PWC use would be limited to the main body of Lake of the Arbuckles and some of its arms (see Figure 1-1).
- PWC use would be prohibited within 150 feet of all shorelines except for certain access areas, such as launch ramps and designated mooring areas.
- PWC use would be prohibited in the no-wake zone in the Guy Sandy arm as currently defined and the no-wake zone in the Rock Creek arm, but extended to just north of The Point campground.
- By April 15, 2005, all PWC would have to meet US EPA's 2006 manufacturing emission standards of a 75% reduction in hydrocarbon emissions.
- Combine and extend the Buckhorn arm no-wake zone to a line drawn between Goddard Youth Camp Cove and the Buckhorn campground A and B loop cove.
- A PWC carrying capacity would be established by limiting PWC permits to day use only, eliminating annual permits, and setting a maximum number of permits per day.
- PWC users would not be allowed to launch at Upper Guy Sandy.
- PWC operators must be 16 years old and possess a valid drivers license.
- Change PWC hours of operation to 9AM to 5PM or limit use to less than 7 days a week (weekend and holiday use only).
- Establishment of a mandatory user education program and increased user fees to cover the educational program.



**Alternative D: No-Action Alternative (Continue PWC Ban)**

Under the no-action alternative, no unit-specific rule would be developed to reinstate PWC use in CHIC. Therefore, PWC use would be prohibited in CHIC permanently, in accordance with *Bluewater Network v. Stanton*, No. CV02093 (D.D.C. 2000), the settlement agreement approved by the court on April 12, 2001, and subsequent September 9, 2002, modification.<sup>3</sup>

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<sup>3</sup> As noted above, PWC are currently banned from CHIC until the publication of the final rule for management of PWC use in the park. Under the no-action alternative, this temporary ban would become permanent.

# 2

## Description of PWC Use in Chickasaw National Recreation Area

CHIC, located in southern Oklahoma, was established in 1906 to provide for the protection of its unique recreational, cultural, and natural resources, including springs, streams, lakes, hiking trails, and historic structures. CHIC consists of 9,889 acres, including 2,346 acres of water and over 36 miles of shoreline (see Figure 1-1).

The springs and streams of CHIC come from one of the most complex geological and hydrological features in the United States. These resources have been economically and environmentally significant throughout the history of the region and are valuable for scientific research. Within the park boundaries are a vast diversity of natural resources. These unique flora, fauna, waters, and geological formations have withstood the external pressures of man-made and natural changes. The combination of these resources has created an area unlike any in the surrounding territory.

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### **2.1 PWC USE, AREA ACCESS, MAINTENANCE, AND ENFORCEMENT AT CHIC**

Although PWC use is currently banned in CHIC (see Section 1.3), this section reviews PWC access, maintenance, and enforcement prior to the ban. According to NPS staff, the earliest record of PWC use at CHIC was in the early 1980s. The typical PWC use season at CHIC lasted from April to September, with the heaviest use concentrated in the summer months.

CHIC did not provide any facilities solely for PWC users. Facility maintenance and law enforcement associated with PWC use at CHIC were incidental to other park services. Motor vessel access to

Lake of the Arbuckles is provided by four paved launch ramps (see Figure 1-1). The launch facilities are located at Upper Guy Sandy, Guy Sandy, The Point, and Buckhorn. There is also a boat launch on Veterans Lake, but PWC were not historically allowed in Veterans Lake. All PWC users were required to obtain a launch permit, but the total number of permits issued may be misleadingly low because many PWC users obtained annual permits.

State PWC regulations that address age requirements, education requirements, timing restrictions, and types of operations were enforced at CHIC. NPS was the sole enforcement agent of PWC regulations in CHIC. If regulations allowing the use of PWC are adopted, enforcement patrols likely would not be increased.

According to NPS records, a total of 20 watercraft accidents have been recorded since 1995 (NPS, 2003). Of these accidents, 10 involved PWC. Also, from 1996 through June 2001, NPS staff issued 162 warnings and citations to boaters for equipment violations, violations of no wake zones, the 150' distance rule, careless operation, boating under the influence, and other infractions. Of the 162 warnings and citations, 85 were issued to PWC operators, comprising 52 percent of all boating warnings and citations issued (NPS, 2001).

Although PWC are more maneuverable and can access more areas than other types of motorized watercraft, at CHIC they generally operated within localized areas. NPS staff previously observed PWC traveling throughout Lake of the Arbuckles, but noted that PWC tended to concentrate in areas near launch ramps just outside no-wake zones, around campgrounds and picnic areas, and in the G Road Cliffs Area in the Buckhorn Creek arm of the lake south of Buckhorn Road. PWC users at CHIC commonly used somewhat open waters where they could travel at high speeds and perform stunts. The PWC used in CHIC were typically 2- to 3-person machines with conventional two-stroke engines.

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## **2.2 VISITATION DATA**

Sections 3 and 4 present analyses of the economic impacts and the social benefits and costs of PWC use under alternative regulations in CHIC from 2003 through 2012. To support the development of these estimates, Section 2.2 presents projections of baseline PWC and non-

PWC visitation for this period and discusses the methodology used to calculate the projections. The projected baseline represents visitation to CHIC after imposing the ban on PWC use, as discussed in Section 1. In addition, projected visitation expected to have occurred in the absence of the ban is presented.

### **2.2.1 Historical CHIC Visitation Data**

CHIC is one of the most heavily visited parks in the National Park System relative to its size, with 3.4 million visitors per year. Subtracting those visitors that are simply passing through the area on the highway that crosses the borders of CHIC, the number of annual recreational visitors is approximately 1.6 million. The peak season is from Memorial Day to Labor Day with activities focusing on water recreation and camping. The lowest visitation occurs in January and February. Table 2-1 presents the 2001 monthly visitation estimates for CHIC. According to NPS reports, the estimated total number of recreational visitors to the CHIC area in 2001 was 1,608,792. As evidenced by Table 2-2, this figure is slightly higher than the annual average over the past 10 years, but lower than the annual average during the 1980s. Between the months of May and September, which corresponds to the typical PWC season in the park, CHIC received 1,112,125 visitors (69 percent of annual visitation). The estimated total number of recreational visitors was based on road traffic counts at park entrances and multiplication of these counts by 3.5 to account for the estimated average number of people per vehicle.

As shown in Table 2-2, visitation to CHIC has fluctuated considerably over the past 2 decades.

### **2.2.2 Historical CHIC Watercraft Visitation Data**

NPS assumes that CHIC park staff have the best available data on total PWC visitation to the park.

PWC visitation data have been collected by NPS staff since October 1999.<sup>1</sup> NPS data show that PWC were a consistent part of the total boating population of the lake, accounting for up to 50 percent of total boating activity during the summer months and 20 to 35 percent of total motorized watercraft annually through 2001 (NPS, 2002a).

Using data from trailer counts performed at strategic locations and times, it was estimated that there were 8,294 PWC use-days in CHIC in 2001 (NPS, 2002a). Estimates from other parks indicate

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<sup>1</sup>Watercraft visitation data are collected only when CHIC staff are on patrol.

**Table 2-1. Monthly  
Recreational Visitation  
to CHIC, 2001**

Month	Recreational Visits
January	26,361
February	58,027
March	81,670
April	139,667
May	204,336
June	222,679
July	282,737
August	235,130
September	167,243
October	69,480
November	72,131
December	49,331
Total	1,608,792

Source: National Park Service (NPS). "Visitation Records."  
<<http://www.nps.gov>>. As obtained in April 2002b..

**Table 2-2. Annual  
Recreational Visitation  
to CHIC, 1979–2001**

Year	Total Visitation	Year	Total Visitation
1979	1,434,484	1991	1,453,032
1980	1,927,044	1992	1,385,386
1981	1,697,658	1993	1,370,475
1982	2,094,319	1994	1,446,711
1983	2,238,456	1995	1,686,136
1984	2,026,727	1996	1,551,574
1985	2,129,513	1997	1,572,079
1986	1,983,835	1998	1,615,577
1987	1,854,417	1999	1,602,065
1988	1,884,537	2000	1,389,537
1989	1,962,353	2001	1,608,792
1990	1,600,628		

Source: National Park Service (NPS). "Visitation Records."  
<<http://www.nps.gov>>. As obtained in April 2002b..

that the average group size for PWC users is approximately 3.67 people per PWC (MACTEC et al. 2002a,b,c).<sup>2</sup> Based on this group size, NPS estimates that about 30,439 people used PWC in CHIC during 2001, or 1.89 percent of total CHIC visitation. However, it should be noted that there is considerable uncertainty surrounding this estimate of PWC visitation based on interviews with park officials.<sup>3</sup>

The Environmental Analysis (EA) conducted for PWC use at CHIC (NPS, 2003) presents data on annual boat launch permits at CHIC, summarized in Table 2-3. Figures are given for total boating activity and for PWC. This type of permit is typically sought only by locals who expect to ride their PWC at CHIC many times during the season and should only be used as an indicator of the prevalence of this type of visitor. The EA also presents statistics on boat registrations in Oklahoma, as seen in Table 2-4. While PWC are not isolated in this dataset, the figures offer a sense of the overall trend in boating activity in the area.

**Table 2-3. Annual Boat Launch Permits at CHIC**

Year	Total Permits Issued	Permits Issued to PWC	Percentage of PWC Permits
1997–1998	928	162	17%
1998–1999	854	127	15%
1999–2000	898	125	14%
2000–2001	882	114	13%

Source: National Park Service (NPS). 2003. *Chickasaw National Recreation Area Personal Watercraft Use Environmental Assessment*. Washington, DC: National Park Service.

Some former PWC users at CHIC used PWC exclusively, while others used PWC in conjunction with other types of boats. Interviews with local businesses revealed that most visitors to CHIC come from outside the local area but within a day's drive. Given the problems associated with transporting and storing PWC, local

<sup>2</sup> This figure is the mean of the corresponding numbers at Big Thicket NP, Lake Meredith NRA, and Glen Canyon NRA.

<sup>3</sup> Because the number of PWC trailers at a particular location are counted only once per day on weekdays, this count may understate the total number of PWC. If PWC users left prior to the daily count or arrived after the daily count, they would not be included. On weekends and holidays, the count is performed twice, but still provides opportunities for individuals to use PWC before, after, or between counts.

**Table 2-4. Oklahoma Boat Registration Statistics, 1996-2001**

Year	Boats Registered	Percentage Change
1996	206,000	
1997	223,267	8.40%
1998	225,021	<0.1%
1999	225,242	<0.1%
2000	229,890	2.10%
2001	221,464	-3.70%
Average		1.25%

Source: National Park Service (NPS). 2003. *Chickasaw National Recreation Area Personal Watercraft Use Environmental Assessment*. Washington, DC: National Park Service.

residents probably factored more heavily in PWC use than in overall park visitation. Because no PWC rentals are available, all users who visited CHIC are assumed to have owned their own PWC.

### 2.2.3 Projected Visitation

#### **Methodology for Projecting Visitation**

To project PWC and non-PWC visitation for the years 2003 through 2012, NPS used the following methodology:

#### **Baseline**

1. Calculate average recreational visitation over the five most recent years with data available (1997–2001).
2. Divide the recreational visitation estimated in Step 1 between PWC and non-PWC visitation using estimates of PWC use in 2001 relative to total recreational visits.
3. Project baseline non-PWC visitation for the period 2003–2012 by allowing non-PWC visitation to change from the 1997–2001 average at the population growth rate for the areas from which most visitors to the park originate. This calculation yields an average annual growth rate of 0.89 percent.
4. Assume there would be no PWC use in 2003–2012 under baseline conditions because of the current ban on PWC use in CHIC.
5. Project visitation by former PWC users by assuming a certain fraction will continue to visit CHIC to engage in activities other than PWC use following the ban. These percentages will typically be based on professional judgment, because of the absence of a formal study of PWC use in CHIC.

### **Without Ban**

1. Calculate average recreational visitation over the five most recent years with data available (1997–2001).
2. Divide the recreational visitation estimated in Step 1 between PWC and non-PWC visitation using an estimate of 30,439 PWC users in 2001. This results in an estimate of PWC users accounting for 1.89 percent of visitation.
3. Estimate PWC visitation for 2003–2012 by using the estimates of annual growth in PWC use presented in the Environmental Assessment (EA) of PWC use at CHIC (NPS, 2003). Although the numbers of PWC owned and sold are declining nationally (NMMA, 2002a,b), local trends are assumed to be a better source of data for projecting PWC use than national trends because locals comprise the majority of PWC users at the park.<sup>4</sup> The annual growth rate in PWC use in CHIC is estimated to be 1.0 percent based on a combination of the trends in boat registration in Oklahoma and annual PWC use permits issued at CHIC (NPS, 2003).

### **Projecting Visitation for 2003 through 2012**

Following the methodology outlined above, NPS calculated CHIC average annual recreational visitation for 1997 through 2001 to be 1,557,610. According to NPS estimates, approximately 1.89 percent of 2001 visitors used a PWC in CHIC. Assuming that the percentage of PWC visitors remains relatively constant over time, this results in an annual average of 29,439 PWC users and 1,528,171 non-PWC users from 1997 to 2001.

Trends in local population and PWC registrations indicate that PWC use at CHIC will increase by 1.0 percent annually if the activity is reinstated in the park.

As described above, NPS projects that non-PWC visitation will grow at the rate of population growth for the areas where most visitors to CHIC originate. In the absence of a ban, visitation by PWC users was projected based on historical PWC use, use trends provided in the EA (NPS, 2003), and interviews with local businesses. NPS believes that most visitors originate from Oklahoma City and Murray County, the county that surrounds the park. According to the U.S. Census, population in these two areas experienced an average growth rate of 0.89 percent annually from 1990 to 2000 (U.S. Census, 2002). This is approximately equal to the national average of 0.9 percent.

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<sup>4</sup>In analyses of PWC regulations in other national parks, NPS has typically relied on the national data because of a lack of park-specific information. However, where local information is readily available, NPS prefers the local data because it should more accurately reflect conditions at a particular park.



For 2003 to 2012, there is assumed to be no baseline PWC use in the park because PWC are banned in the baseline as of November 2002. However, many of the former PWC users who can no longer use a PWC in CHIC may continue to visit the park to pursue other types of recreation. It was assumed that 50 percent of the former PWC users would continue to visit the CHIC region under the ban. This percentage is based on professional judgment and reflects both the scarcity of substitute areas for PWC use nearby, which would tend to push this fraction up, and the fact that PWC use was likely the primary purpose of a large number of PWC users' visits to CHIC before the ban, which would tend to push this fraction down. Based on the estimated regional population growth rate, the projected change in PWC ownership, and the assumed percentage of former PWC users who voluntarily stop using PWC in the park that will continue to visit the park for other activities, NPS presents the projected baseline visitation for CHIC from 2003 to 2012 in Table 2-5.

To estimate the incremental impacts of the alternative management strategies (see Sections 3 and 4), the change in visitation relative to these baseline conditions must be projected. Table 2-6 presents the projected visitation that would have taken place in the absence of the November 2002 ban on PWC use in CHIC.

#### **2.2.4 Sources of Uncertainty in Visitation Projections**

NPS estimates of PWC and non-PWC visitation in the years 2003 through 2012 are based on a number of assumptions. In addition, a variety of unpredictable circumstances could impact visitation in a particular year. In general, visitation to CHIC in a specific year will depend on many factors, including

- economic conditions,
- weather,
- natural resource conditions,
- national and state regulations that may affect PWC use or prices, and
- alternative recreational activities available.

Although many of these factors are difficult to predict, a recent regulation enacted by the U.S. EPA in 1996 may affect PWC use nationally and in CHIC. The 1996 EPA rule for New Gasoline Spark-

**Table 2-5. Projected Baseline Visitation to CHIC, 2003–2012<sup>a</sup>**

Year	PWC Users	Non-PWC Users		Total Non-PWC Users	Total Visitation
		Non-PWC Users in the Absence of the Ban	Visitors that Would Have Used PWC in the Absence of the Ban <sup>b</sup>		
2003	0	1,555,561	14,883	1,570,444	1,570,444
2004	0	1,569,456	14,883	1,584,338	1,584,338
2005	0	1,583,474	14,883	1,598,357	1,598,357
2006	0	1,597,618	14,883	1,612,501	1,612,501
2007	0	1,611,889	14,883	1,626,771	1,626,771
2008	0	1,626,287	14,883	1,641,169	1,641,169
2009	0	1,640,813	14,883	1,655,696	1,655,696
2010	0	1,655,469	14,883	1,670,352	1,670,352
2011	0	1,670,256	14,883	1,685,139	1,685,139
2012	0	1,685,176	14,883	1,700,058	1,700,058

<sup>a</sup>These projections are based on the estimated regional population growth rate, the projected change in PWC ownership, and the assumed percentage of former PWC users who voluntarily stop using PWC in the park that will continue to visit the park for other activities. There is no PWC use in the park after November 6, 2002, under baseline conditions because PWC were banned on that date. Because this date is after the primary 2002 PWC use season, it was assumed that PWC use at CHIC continued at normal levels in 2002.

<sup>b</sup>This category represents visitors who would have used PWC in CHIC in the absence of the ban, but would continue to visit the park to engage in alternative activities following the ban. These values were calculated based on an assumption that 80 percent of those people that would have used PWC in the park in the absence of the ban would continue to visit the park to engage in alternative activities.

Ignition Marine Engines<sup>5</sup> (hereafter referred to as the 1996 EPA Marine Engine Rule) requires PWC (and other spark-ignition [SI] marine engine) manufacturers to reduce emissions by 75 percent from the 1998 model year until the 2006 model year (*Federal Register*, 1996). In their analysis of the rule, EPA predicted that the emissions from all of the regulated engines in use will decrease by approximately 75 percent from baseline emission levels by the year 2025. The delay in actual emission reductions for machines in use is

<sup>5</sup>In 1996, EPA promulgated a rule to control exhaust emissions from new spark-ignition marine engines, including outboards and PWC. Emission controls provide for increasingly stricter standards beginning in model year 1998, with all PWC manufactured after 2006 required to be EPA emissions-compliant (i.e., to reduce hydrocarbon emissions by 75 percent from unregulated levels) (*Federal Register*, 1996).

**Table 2-6. Projected Visitation to CHIC in the Absence of the Ban on PWC Use, 2002–2012**

Year	PWC Users	Non-PWC Users	Total Visitation
2003	29,765	1,555,561	1,585,326
2004	30,063	1,569,456	1,599,519
2005	30,364	1,583,474	1,613,838
2006	30,667	1,597,618	1,628,286
2007	30,974	1,611,889	1,642,863
2008	31,284	1,626,287	1,657,570
2009	31,596	1,640,813	1,672,410
2010	31,912	1,655,469	1,687,382
2011	32,232	1,670,256	1,702,488
2012	32,554	1,685,176	1,717,729

due to the long lives of some marine engines. EPA predicts that complete fleet turnover for some engines may not occur until 2050. However, EPA assumes that the life cycle for PWC is 10 years, considerably shorter than their assumptions for the life cycles of some of the other SI marine engines covered by the rule (*Federal Register*, 1996). According to the Personal Watercraft Industry Association (PWIA), PWC manufacturers have already reduced the emissions of PWC significantly, and many of the newer PWC models already comply with the 1996 EPA Marine Engine Rule (PWIA, 2002).

Without additional data, it is difficult to predict whether the assumptions used by NPS will bias the projections upward or downward.

It is also possible that publicity surrounding the proposed NPS PWC rules may have affected PWC use prior to the ban. PWC sales have been declining nationally over the past few years. However, the sales decline began in 1996, which is before NPS first proposed rules restricting PWC in national parks. This suggests that other factors also may be involved in the national recent sales decline. Nonetheless, it is possible that baseline PWC use would have been higher in the absence of recent negative publicity.

NPS identified the following additional uncertainties in the projections of baseline visitation:

- The estimate of 2001 PWC use represents the park's best estimate of use, using permit sales and trailer counts. However, this figure is potentially inaccurate.

- NPS estimates of total visitation to CHIC are based on traffic counters and an assumed group size of 3.0 people per party. To the extent that the actual average group size differs from 3.0 for either overall visitation or PWC users in particular, visitation estimates for these groups may be biased upward or downward.
- NPS projects growth in non-PWC visitation based on population growth in the surrounding counties and in nearby metropolitan areas. As discussed above, a number of factors could affect visitation in any one year or the trend in visitation over time. However, NPS believes that regional population growth, which should be related to economic conditions, represents the best available proxy for change in visitation.
- NPS makes assumptions about the number of former PWC users who will return in the future under the existing ban. These assumptions represent NPS' best estimate, but the actual percentage of former PWC users that continue to visit the park for alternative recreation activities may be higher or lower.

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### **2.3 ALTERNATE LOCATIONS FOR PWC USE NEARBY**

Other areas for PWC use in the vicinity of CHIC include Lake Murray, 30 miles to the south, Lake Texoma, 60 miles to the south, and Lake Thunderbird, 60 miles to the north near Oklahoma City. The other nearby waters are also popular boating destinations. Owners of local businesses affirm that these lakes are larger but less scenic than Lake of the Arbuckles. Some visitors to CHIC may consider them poor substitutes because of this difference in aesthetic value, but NPS considers these alternative lakes to be close substitutes for the purposes of this report.

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### **2.4 OTHER MAJOR SUMMER ACTIVITIES IN CHIC**

The park provides opportunities to experience a wide range of outdoor experiences—wildlife viewing, day hiking, bird watching, kayaking, canoeing, sailing, swimming, water-skiing, camping, fishing, hunting, and picnicking. It adds measurably to the quality of life for visitors and area residents. The park offers three different levels of water-based recreation. In the protected zone upstream from the nature center, visitors can enjoy the beauty of the natural springs and streams as a visual resource. Veteran's Lake offers a park-like atmosphere, where use is restricted to a slower pace and

relatively quiet activities. At Lake of the Arbuckles, visitors can engage in a full range of activities, including boating and fishing.

Few conflicts between PWC users and other visitors have been reported. During several public meetings held to discuss the PWC rulemaking, NPS staff have received comments indicating the need for better enforcement/education of existing PWC rules.

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## **2.5 NATURAL RESOURCES AND LIKELY ECOLOGICAL IMPACTS OF PWC USE IN PARK**

The following section provides an assessment of the natural resources at CHIC and the potential impacts to park resources under the proposed PWC management alternatives identified in Section 1.4. NPS conducted an impairment analysis to assess the magnitude of impacts to park resources under various PWC management alternatives. Details of this analysis, including guiding regulations and policies as well as methodologies and assumptions, are described in the *Personal Watercraft Use, Environmental Assessment* (NPS, 2003) for CHIC. Conclusions based on the impact analysis for each alternative are presented below.<sup>6</sup> Impacts are assessed using current conditions as baseline and comparing them with the proposed alternatives (see Section 1). The following impact thresholds were established in the CHIC EA to describe the relative changes in resources:

Negligible: Impacts are not detectable, below resource standards or criteria, and within historical or baseline conditions of the park.

Minor: Impacts would be detectable but would be below the resource standards or criteria and within historical or desired conditions of the park.

Moderate: Impacts would be detectable but at or below the resource standards or criteria; however, conditions would be altered on a short-term basis.

Major: Impacts would be detectable and frequently altered from historical or baseline conditions in the park, and would exceed resource standards or criteria slightly and singularly on a short-term and temporary basis.

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<sup>6</sup>The EA assessed the potential impacts of the alternatives prior to the PWC ban.

Impairment: Impacts would be detectable and substantially and frequently altered from historical or baseline conditions in the park, and would frequently exceed resource standards or criteria on a short-term and temporary basis. The impacts would involve deterioration of the park's resources over the long term, to the point that the park's purpose could not be fulfilled.

Impacts have been assessed using current conditions (i.e., the PWC ban) as the baseline and comparing them with the conditions likely under the proposed alternatives (see Section 1.4).

### **2.5.1 Water Quality**

Most research on the effects of PWC use on water quality focuses on the impacts of two-stroke engines and assumes that impacts caused by these engines also apply to the PWC powered by them. The typical conventional (i.e., carbureted) two-stroke PWC engine intakes a mixture of air, gasoline, and oil into the combustion chamber, expels exhaust gases from the combustion chamber, and discharges as much as 30 percent of the unburned fuel mixture as part of the exhaust (California Air Resources Board, 1999). At common fuel consumption rates, an average 2-hour ride on a PWC may result in the discharge of 3 gallons (11.34 liters) of fuel into the water (VanMouwerik and Hagemann, 1999).

Contaminants released into the environment due to PWC use include those present in the raw fuel itself and those that are formed during its combustion. Fuel used in PWC engines contains many hydrocarbons, including volatile organic compounds (VOCs) such as benzene, toluene, ethylbenzene, and xylene (collectively referred to as BTEX) and methyl tertiary butyl ether (MTBE). Unburned PWC fuel does not contain appreciable levels of polycyclic aromatic hydrocarbons (PAHs), but several PAHs are formed as a result of its combustion (i.e., phenanthrene, pyrene, chrysene, benzo(a)pyrene, and acenaphthylene) (VanMouwerik and Hagemann, 1999). Other hydrocarbons that are not present in PWC fuel but are by-products of incomplete combustion include formaldehyde, acetaldehyde, diesel particulate matter (PM), and 1,3-butadiene (EPA, 1994).

Unburned fuel and combustion by-products are released to the environment in PWC exhaust. Because of differences in chemical and physical characteristics, BTEX released into the water readily transfers from water to air, whereas most PAHs and MTBE do not.

Therefore, water quality issues associated with BTEX in the water column are less critical than those associated with PAHs and MTBE (VanMouwerik and Hagemann, 1999).

Compounds released in water due to PWC use are known to cause adverse health effects to humans and aquatic organisms. Exhaust emissions from two-stroke engines have been specifically shown to cause toxicological effects in fish (Tjarnlund et al., 1995, 1996; Oris et al., 1998). Sunlight can further increase the toxic effect of PAHs to aquatic organisms (Mekenyan et al., 1994; Arfsten, Shaeffer, and Mulveny, 1996). Research evaluating the possible phototoxic effects of some PAHs to aquatic organisms (NCER, 1999) has demonstrated that toxicity may vary due to a number of factors including (1) length of exposure, (2) turbidity, humic acid, and organic carbon levels, (3) the location of the organism relative to the surface of the water or the sediment, and (4) weather (NCER, 1999). For instance, increased turbidity or organic carbon tended to reduce toxicity, while increasing the length of exposure tended to increase toxicity and proximity to the surface might increase toxicity (i.e., shallow waters).

New PWC engines, including direct injection two-stroke engines and four-stroke engines, will decrease the amount of unburned fuel that escapes with PWC exhaust and will result in decreases in emissions (VanMouwerik and Hagemann, 1999). As a result of EPA's 1996 rule requiring cleaner running spark-ignited marine engines,<sup>7</sup> a 50 percent reduction of current hydrocarbon emissions from these engines is expected by 2020, and a 75 percent reduction in hydrocarbon emissions is expected by 2025 (*Federal Register*, 1996).

Overall, the impact of PWC use on water quality at CHIC is very limited.

### **Baseline Water Quality Conditions at CHIC**

As noted in the CHIC EA (NPS, 2003), CHIC does not have quantitative water quality data documenting the effects of PWC use prior to the ban. Because PWC are currently banned from CHIC, they have no impact on water quality.

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<sup>7</sup>In 1996, EPA promulgated a rule to control exhaust emissions from new SI marine engines, including outboards and PWC. Emission controls provide for increasingly stricter standards beginning in model year 1998, with all PWC manufactured after 2006 required to be EPA emissions compliant (i.e., to reduce hydrocarbon emissions by 75 percent from unregulated levels) (*Federal Register*, 1996).

**Potential Impact of PWC Use on Water Quality Under the Proposed Management Alternatives**

**Alternative A: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation.** Historically, the impact of PWC use on water quality at CHIC was assumed to be very limited. This was due to the limited numbers of PWC on the lake and the fact that water quality is affected by non-PWC related stressors, including other watercraft. As described in the CHIC EA (NPS, 2003), reinstating PWC use would have negligible adverse impacts on water quality based on ecotoxicological benchmarks and human health benchmarks for benzo(a)pyrene. The impact from benzene, based on human health benchmarks, would be minor in the main body of the lake and would be moderate to minor in the no-wake zones. On a cumulative basis, all pollutant loads from PWC and other motorboat use based on ecotoxicological benchmarks would be negligible. Water quality impacts from benzene could be major in Lake of the Arbuckles and the no wake zones when compared to human health benchmarks. Water quality monitoring may be required to confirm impacts following high-use days. This alternative is not expected to result in an impairment of the water quality resource.

**Alternative B: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation But With Additional Management Restrictions.** As described in the CHIC EA (NPS, 2003), reinstating PWC use with additional management restrictions would have negligible adverse impacts on water quality based on ecotoxicological benchmarks and human health benchmarks for benzo(a)pyrene. The impact from benzene, based on human health benchmarks, would be minor in the main body of the lake and would be moderate to minor in the no-wake zones. On a cumulative basis, all pollutant loads from PWC and other motorboat use based on ecotoxicological benchmarks would be negligible. Water quality impacts from benzene could be major in Lake of the Arbuckles and the no wake zones when compared to human health benchmarks. Water quality monitoring may be required to confirm impacts following high-use days. This alternative is not expected to result in an impairment of the water quality resource.

**Alternative C: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation, But Limit Use Areas.**



As described in the CHIC EA (NPS, 2003), reinstating PWC use with limited access would have negligible adverse impacts on water quality based on ecotoxicological benchmarks and human health benchmarks for benzo(a)pyrene. The impact from benzene, based on human health benchmarks, would be moderate upon implementation, decreasing to negligible in 10 years. On a cumulative basis, all pollutant loads from PWC and other motorboat use based on ecotoxicological benchmarks would be negligible, but may be higher in the main body of Lake of the Arbuckles because of PWC use displaced from Upper Guy Sandy and Rock Creek arms. Water quality impacts from benzene could be major in Lake of the Arbuckles and moderate in the no wake zones when compared to human health benchmarks. Water quality monitoring may be required to confirm impacts following high-use days. This alternative is not expected to result in an impairment of the water quality resource.

**Alternative D: No-Action Alternative—Continue PWC Ban.** No impacts to water quality from PWC would occur within CHIC if the ban continued.

### **2.5.2 Air Quality**

Air quality and visibility can be impacted by emissions from two-stroke engines such as PWC motors. Emissions from PWC in national parks are one of many potential (albeit, relatively small) sources of these air quality and visibility impairments.

Recreational marine engines, including PWC and outboard motors, contribute approximately 30 percent of national non-road engine emissions and are the second largest source of non-road engine hydrocarbon emissions nationally (*Federal Register*, 1996). According to the results of a 1990 inventory of emissions in California, watercraft engines were estimated to account for 141 tons of smog-forming reactive organic gases (ROG) 1,063 tons of carbon monoxide (CO), and 31 tons of nitrogen oxides (NO<sub>x</sub>) emitted per day (Kado et al., 2000). A study comparing emissions from conventional and direct-injected two-stroke engines with four-stroke engines found that the new four-stroke engine has considerably lower emissions of PM, PAHs, and substances with genotoxic activity (Kado et al., 2000). Based on a comparison with a typical 90-horsepower engine, it is estimated the ban of conventional two-stroke engines would result in

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*Up to one-third of the fuel delivered to conventional two-stroke engines goes unburned and is discharged as gaseous hydrocarbons.*

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a four-fold decrease in smog-forming pollution per engine (VanMouwerik and Hagemann, 1999).

Although PWC engine exhaust is usually routed below the waterline, a portion of the exhaust gases is released to the air and may affect air quality. Up to one-third of the fuel delivered to conventional two-stroke engines goes unburned and is discharged as gaseous HCs; the lubricating oil is used once and is expelled as part of the exhaust; and the combustion process results in emissions of air pollutants such as BTEX, MTBE, PAHs, NO<sub>x</sub>, PM, and CO (Kado et al., 2000). PWC also contribute to the formation of ozone (O<sub>3</sub>) in the atmosphere, which is formed when HCs react with NO<sub>x</sub> in the presence of sunlight (EPA, 1993). (See Section 2.5.1 for further discussion of burned and unburned constituents of PWC emissions.) These compounds are known to cause adverse health effects in both humans and plants. They may adversely impact park visitor and employee health, as well as sensitive park resources.

O<sub>3</sub> causes respiratory problems in humans, including coughing, airway irritation, and chest pain during inhalation. O<sub>3</sub> is also toxic to sensitive species of vegetation. It causes visible foliar injury, decreases plant growth, and increases plant susceptibility to insects and disease (EPA, 1993).

CO can interfere with the oxygen-carrying capacity of blood, resulting in lower delivery of oxygen to tissues. NO<sub>x</sub> and PM emissions associated with PWC use can also degrade visibility. Adverse health effects have been associated with airborne PM, especially less than 10 µm aerodynamic diameter (PM<sub>10</sub>) (Kado et al., 2000). NO<sub>x</sub> also contributes to acid deposition effects on plants, water, and soil.

### **Baseline Air Quality Conditions at CHIC**

No specific air quality information is available for CHIC. Air quality is generally good at CHIC, and the recreation area is designated as a Federal Class II air quality area. Because PWC are currently banned from CHIC, they have no impact on air quality.

### **Potential Impact of PWC Use on Air Quality Under the Proposed Management Alternatives**

**Alternative A: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation.** The impact of PWC

use on air quality at CHIC was considered to be minimal, prior to the ban, relative to the contribution of contaminants to air shed from non-PWC-related stressors, including automobiles in the recreation area and other watercraft. As described in the CHIC EA (NPS, 2003), reinstating PWC use at CHIC would result in a moderate adverse impact from CO, a minor adverse impact from VOC, and negligible adverse impacts from PM<sub>10</sub> and NO<sub>x</sub> upon implementation. After 10 years, the impact from CO would remain moderate, while impacts from VOC, PM<sub>10</sub>, and NO<sub>x</sub> impacts would be negligible. Reinstating PWC use would have negligible adverse impacts on visibility and minor adverse impacts on ozone exposure. Cumulative emission impacts would be negligible for PM<sub>10</sub> and NO<sub>x</sub>, while CO would be moderate and VOC would be moderate, decreasing to minor in 10 years. This alternative would not result in an impairment of air quality or air quality related values.

**Alternative B: Reinstatement PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation But With Additional Management Restrictions.** As described in the CHIC EA (NPS, 2003), reinstating PWC use at CHIC would result in a moderate adverse impact from CO, a minor adverse impact from VOC, and negligible adverse impacts from PM<sub>10</sub> and NO<sub>x</sub> upon implementation. After 10 years, the impact from CO would remain moderate, while impacts from VOC, PM<sub>10</sub>, and NO<sub>x</sub> impacts would be negligible. Extending the no-wake zone in the area of the Buckhorn developed area would reduce the emissions of all pollutants, except NO<sub>x</sub>, in comparison to Alternative A. Reinstating PWC use would have negligible adverse impacts on visibility and minor adverse impacts on ozone exposure. Cumulative emission impacts would be negligible for PM<sub>10</sub> and NO<sub>x</sub>, while CO would be moderate and VOC would be moderate, decreasing to minor in 10 years. This alternative would not result in an impairment of air quality or air quality related values.

**Alternative C: Reinstatement PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation, But Limit Use Areas.** As described in the CHIC EA (NPS, 2003), reinstating PWC use at CHIC would result in a moderate adverse impact from CO, a minor adverse impact from VOC, and negligible adverse impacts from PM<sub>10</sub> and NO<sub>x</sub> upon implementation. Emissions would be reduced compared to Alternative A because no-wake zones would be

extended and areas would be closed to PWC. After 10 years, the impact from CO would be minor as a result of an overall reduction in the number of carbureted two-stroke engines, while impacts from VOC, PM<sub>10</sub>, and NO<sub>x</sub> impacts would be negligible. Reinstating PWC use would have negligible adverse impacts on visibility and minor adverse impacts on ozone exposure. Cumulative emission impacts would be negligible for PM<sub>10</sub> and NO<sub>x</sub>, while CO would be moderate and VOC would be minor, decreasing to negligible in 10 years. This alternative would not result in an impairment of air quality or air quality related values.

**Alternative D: No-Action Alternative—Continue PWC Ban.** No impacts to air quality or related values from PWC would occur within CHIC if the ban continued.

### 2.5.3 Soundscapes

PWC emit up to 105 dB per unit at 82 feet, which may disturb park users (visitors and residents). NPS has established a noise limit of 82 dB at 82 feet. Noise from PWC may be more disturbing than noise from a constant source at 90 dB due to rapid changes in acceleration and direction of noise (EPA, 1974) and their ability to be driven in shallow water close to the shoreline. However, the newer, compliant models of PWC may be up to 50 to 70 percent quieter than the older models (PWIA, 2002a).

#### **Baseline Soundscape Conditions at CHIC**

One aspect of experiencing CHIC's resources is the ability to hear the sounds associated with its natural resources, often referred to as "natural sounds" or "natural quiet." Natural sounds generally include the naturally-occurring sounds of winds in the trees, calling birds, and the quiet associated with still nights. "Noise" is defined as unwanted sound. Sounds are described as noise if they interfere with an activity or disturb the person hearing them.

Typical sounds at CHIC include waves, wind, visitors talking, motorboats, and road noise from automobiles in the recreation area. High-use areas, such as around boat launches, have higher ambient noise levels, particularly for boats launching and landing. Because PWC are currently banned from CHIC, they have no impact on the soundscape.

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*Natural sounds generally include the naturally-occurring sounds of winds in the trees, calling birds, and the quiet associated with still nights.*

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**Potential Impact of PWC Use on Soundscape Under the Proposed Management Alternatives**

**Alternative A: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation.** As described in the CHIC EA (NPS, 2003), PWC noise would have minor to moderate, temporary, adverse impacts over the short and long term at most locations on Lake of the Arbuckles and the immediate surrounding area. Over the long term, PWC noise levels would be reduced with the introduction of newer engine technologies. Cumulative noise impacts from PWC, motorboats, and other visitors would be minor to moderate because these sounds would be heard occasionally throughout the day, and these sounds could predominate on busy days during the high-use season. NPS anticipates that this alternative would not result in an impairment of the soundscape at CHIC.

**Alternative B: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation But With Additional Management Restrictions.** As described in the CHIC EA (NPS, 2003), PWC noise would have minor to moderate, temporary, adverse impacts over the short and long term at most locations on Lake of the Arbuckles and the immediate surrounding area. Expanding the no-wake zone around the Buckhorn developed area would have a beneficial effect, although it would not change overall impact types or threshold levels. Over the long term, PWC noise levels would be reduced with the introduction of newer engine technologies. Cumulative noise impacts from PWC, motorboats, and other visitors would be minor to moderate because these sounds would be heard occasionally throughout the day, and these sounds could predominate on busy days during the high-use season. This alternative would not result in an impairment of the soundscape at CHIC.

**Alternative C: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation, But Limit Use Areas.** As described in the CHIC EA (NPS, 2003), PWC noise would have minor to moderate, temporary, adverse impacts over the short and long term at many locations on Lake of the Arbuckles and the immediate surrounding area, with potentially moderate impacts at some high-use areas. Restrictions in Alternative C would produce a beneficial effect on the soundscape of the park, reducing noise

levels and periods of potential impact. Cumulative noise impacts from PWC, motorboats, and other visitors would be minor to moderate because these sounds would be heard occasionally throughout the day, and these sounds could predominate on busy days during the high-use season. Impacts would more often be minor rather than moderate. This alternative would not result in an impairment of the soundscape at CHIC.

**Alternative D: No-Action Alternative—Continue PWC Ban.** No impacts to the natural soundscape from PWC would occur within CHIC if the ban continued.

#### **2.5.4 Wildlife and Wildlife Habitat**

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*PWC may affect wildlife by interrupting normal activities, inducing alarm or flight responses, causing animals to avoid habitat, and potentially affecting reproductive success.*

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PWC may affect wildlife by interrupting normal activities, inducing alarm or flight responses, causing animals to avoid habitat, and potentially affecting reproductive success. These effects are thought to be caused by a combination of PWC speed, noise, and ability to access sensitive areas, especially in shallow water (WDNR, 2000). PWC potentially can access sensitive shorelines and disturb riparian habitats critical to wildlife. When run in very shallow water, PWC can disturb the substrate, including aquatic plants and benthic invertebrates. At certain times of year, PWC may also affect fish breeding and nursery areas. Furthermore, water quality degradation caused by PWC can affect migratory avian species in the area.

Waterfowl and nesting birds may be particularly sensitive to PWC because of their noise, speed, and unique ability to access shallow water. This may force nesting birds to abandon eggs during crucial embryo development stages, keep adults away from nestlings, thereby preventing them from defending the nest against predators, and flush waterfowl from habitat, causing stress and associated behavior changes (WDNR, 2000; Burger, 1998; Rodgers and Smith, 1997).

#### **Baseline Wildlife and Wildlife Habitat Conditions at CHIC**

Mammals commonly found in CHIC include coyote, cottontail rabbit, bobcat, fox squirrel, whitetail deer, beaver, and armadillo. Various reptiles inhabit the area, including the poisonous western diamondback rattlesnake and turtles. Common birds include roadrunner, wild turkey, bobwhite quail, scissor-tailed flycatcher, red-tailed hawk, and barred owl. Principal fish species are bass

(largemouth, smallmouth, and spotted), channel catfish, white crappie, sunfish, and carp. Because PWC are currently banned from CHIC, they have no impact on wildlife or wildlife habitat at CHIC.

***Potential Impact of PWC Use on Wildlife Habitat Under the Proposed Management Alternatives***

**Alternative A: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation.** As described in the CHIC EA (NPS, 2003), Alternative A would allow PWC use in all designated areas in Lake of the Arbuckles and would result in negligible to minor, temporary impacts on wildlife and waterfowl from PWC-generated noise, physical disturbance, and emissions. On a cumulative basis, all visitor activities would continue to have negligible to minor adverse effects on wildlife and wildlife habitat. This alternative would not result in an impairment of wildlife or wildlife habitat.

**Alternative B: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation But With Additional Management Restrictions.** As described in the CHIC EA (NPS, 2003), this alternative would result in negligible to minor, temporary impacts on wildlife and waterfowl from PWC-generated noise, physical disturbance, and emissions, similar to Alternative A. On a cumulative basis, all visitor activities would continue to have negligible to minor adverse effects on wildlife and wildlife habitat. This alternative would not result in an impairment of wildlife or wildlife habitat.

**Alternative C: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation, But Limit Use Areas.** As described in the CHIC EA (NPS, 2003), Alternative C would have some beneficial effect on wildlife and waterfowl when compared to Alternative A as a result of restricted PWC use at certain times and in certain locations, as well as requiring PWC to meet the EPA emission standards by 2005. Direct impacts would be eliminated in all areas closed to PWC use, including a 150-foot buffer along the lake shoreline (except for launching areas). Restricting use during early morning and dusk, when wildlife are most abundant and vulnerable, would be beneficial. Similar to the other alternatives, PWC use would have negligible to minor, temporary, adverse

impacts on wildlife; however, additional use restrictions would result in beneficial impacts. On a cumulative basis, all visitor activities would continue to have negligible to minor adverse effects on wildlife and wildlife habitat. This alternative would not result in an impairment of wildlife or wildlife habitat.

**Alternative D: No-Action Alternative—Continue PWC Ban.** No impacts to the wildlife or wildlife habitat from PWC would occur within CHIC if the ban continued.

### **2.5.5 Threatened, Endangered, and Special Concern Species**

PWC may affect threatened, endangered, and special species of concern in the same manner they affect wildlife such as by disrupting or degrading the quality of habitat, interrupting normal activities, inducing alarm or flight responses, causing animals to avoid habitat, and potentially affecting reproductive success.

#### ***Current Conditions of Threatened, Endangered, and Special Concern Species at CHIC***

Three federal protected species are listed in Murray County, and all three species have been observed in CHIC. The three species are the interior least tern (endangered), the whooping crane (endangered), and the bald eagle (threatened).

#### ***Baseline Impact of PWC Use on Threatened, Endangered, and Special Concern Species at CHIC***

Because PWC are currently banned from CHIC, they have no impact on threatened, endangered, or special concern species at CHIC.

#### ***Potential Impact of PWC Use on Threatened and Endangered Species Under the Proposed Management Alternatives***

**Alternative A: Reinstate PWC Use as Previously Managed Prior to November 202, Under a Special Regulation.** NPS staff indicate that there was no noticeable impact of PWC on the three federally protected species at CHIC or their associated habitat when PWC use was allowed at CHIC. As described in the CHIC EA (NPS, 2003), reinstating PWC use may affect, but is not likely to adversely affect, any listed wildlife or plant species that may occur at CHIC. PWC use would not likely adversely affect any of the special status



species since interactions would be extremely limited. While some birds could exhibit a stress or flight response because of PWC activities, impacts would be temporary. Long term water quality effects on the amphipod population are not known. Cumulative effects from all park visitor activities are not likely to adversely affect listed wildlife species because they are transient winter residents, and impacts on individual plants would not jeopardize species populations in CHIC. This alternative would not result in an impairment of any listed species at CHIC.

**Alternative B: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation But With Additional Management Restrictions.** As described in the CHIC EA (NPS, 2003), PWC use under Alternative B may affect, but is not likely to adversely affect, any listed wildlife or plant species that may occur at CHIC. While some disturbance could occur to transient wildlife species from off-season PWC use, the impacts would not be of sufficient duration or intensity to cause adverse impacts. No impacts would occur in areas where PWC use would be prohibited. As described for Alternative A, cumulative effects from all park visitor activities are not likely to adversely affect listed wildlife species because they are transient winter residents, and impacts on individual plants would not jeopardize species populations in CHIC. This alternative would not result in an impairment of any listed species at CHIC.

**Alternative C: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation, But Limit Use Areas.** As described in the CHIC EA (NPS, 2003), PWC use under Alternative C may affect, but is not likely to adversely affect, any listed wildlife or plant species that may occur at CHIC. While some disturbance could occur to transient wildlife species from off-season PWC use, the impacts would not be of sufficient duration or intensity to cause adverse impacts. No impacts would occur in areas where PWC use would be prohibited. As described for Alternative A, cumulative effects from all park visitor activities are not likely to adversely affect listed wildlife species because they are transient winter residents, and impacts on individual plants would not jeopardize species populations in CHIC. This alternative would not result in an impairment of any listed species at CHIC.

**Alternative D: No-Action Alternative—Continue PWC Ban.** No impacts of threatened and endangered species from PWC would occur within CHIC if the ban continued.

#### **2.5.6 Shorelines and Shoreline Vegetation**

PWC use may adversely affect shoreline habitat, including the shoreline, shoreline vegetation and submerged aquatic vegetation (SAV) beds. Shoreline and shoreline vegetation provide critical habitat for the juvenile stages of fish, as well as aquatic invertebrates, shellfish, waterfowl, and other fish life stages. SAV beds are critical to aquatic organisms because they reduce wave action, support nursery fish, provide protection from predators, stabilize sediment, and provide food for many species.

PWC can access areas where most other watercraft cannot go due to their shallow draft and thus may affect shoreline and shoreline vegetation. In addition, PWC may land on the shoreline, allowing visitors to access and disturb areas where sensitive plant species exist. In addition, wakes created by PWC may cause erosion. Turbulence from boat propellers near the shoreline can also erode the shoreline by destabilizing the bottom (WDNR, 2000).

PWC use can affect SAV by increasing turbidity, which may result in decreased sunlight available for SAV, limit vegetation growth, and ultimately reduce water quality. PWC use in shallow water supporting SAV may reduce its value as important habitat for animals, by redistributing the plants and organisms that use these grasses for habitat.

#### **Baseline Condition of Shorelines and Shoreline Vegetation at CHIC**

The shoreline of Lake of the Arbuckles is fairly steep and rocky and the lake itself is deep and does not have many areas of shallow water or shoreline vegetation. When the reservoir is at full pool, wave action caused by watercraft and wind could affect shoreline vegetation. However, there are no sensitive shoreline plant species. Because PWC are currently banned from CHIC, they have no impact on shorelines or shoreline vegetation.

**Potential Impact of PWC Use on Shoreline and Shoreline Vegetation Under the Proposed Management Alternatives**

**Alternative A: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation.** As described in the CHIC EA (NPS, 2003), PWC use would be allowed in all designated areas in Lake of the Arbuckles and would result in negligible to minor, localized adverse impacts on shoreline vegetation over the short and long term, with no perceptible changes in plant community size, integrity, or continuity. Cumulative impacts include other sources of shoreline erosion that create impacts greater than those caused by PWC use, including high boat use. Overall, PWC and other sources of cumulative impacts would create negligible to minor, short and long term, adverse impacts on the shoreline or shoreline vegetation. This alternative would not result in an impairment of shoreline vegetation.

**Alternative B: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation But With Additional Management Restrictions.** As described in the CHIC EA (NPS, 2003), PWC use would result in negligible to minor, localized adverse impacts to sensitive shoreline vegetation over the short and long term, with no perceptible changes in plant community size, integrity, or continuity. Monitoring under this alternative would provide beneficial feedback on the condition of certain areas. Cumulative impacts include other sources of shoreline erosion that create impacts greater than those caused by PWC use, including high boat use. Overall, PWC and other sources of cumulative impacts would create negligible to minor, short and long term, adverse impacts on the shoreline or shoreline vegetation. There would be no perceptible changes in plant community size, integrity, or continuity. This alternative would not result in an impairment of shoreline vegetation.

**Alternative C: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation, But Limit Use Areas.** As described in the CHIC EA (NPS, 2003), restricted PWC use would result in beneficial impacts to sensitive shoreline vegetation over the short and long term, with no perceptible changes in plant community size, integrity, or continuity. Cumulative impacts include other sources of shoreline erosion that create impacts

greater than those caused by PWC use, including high boat use. There would be a negligible reduction of overall impacts by restricted PWC use. This alternative would not result in an impairment of shoreline vegetation.

**Alternative D: No-Action Alternative—Continue PWC Ban.** No impacts to shoreline vegetation from PWC would occur within CHIC if the ban continued.

### **2.5.7 Cultural Resources**

There are known archaeological sites above and below the normal pool elevation of Lake of the Arbuckles. An archaeological survey was completed in 1965 prior to completion of the lake. Identified resources included small temporary campsites or workshop areas.

Fluctuations in the lake level may expose archaeological sites that were previously submerged. NPS staff indicated that wave action as a result of watercraft, including PWC, could increase erosion rates at these sites, but no evidence of impacts has been observed. Because PWC are currently banned from CHIC, they have no impact on cultural resources.

#### ***Potential Impact of PWC Use on Cultural Resources Under the Proposed Alternatives***

**Alternative A: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation.** As described in the CHIC EA (NPS, 2003), reinstating PWC use within CHIC could have minor adverse impacts on archaeological sites and submerged resources from possible illegal collection and vandalism. This alternative would not impact any known ethnographic or traditional use areas along the shoreline of Lake of the Arbuckles. Cumulative impacts on archaeological and submerged cultural resources that are readily accessible could be minor to moderately adverse, as a result of the number of visitors and the potential for illegal collection or destruction. This alternative would not result in an impairment of cultural or ethnographic resources.

**Alternative B: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation But With Additional Management Restrictions.** As described in the CHIC EA (NPS, 2003), reinstating PWC use within CHIC could have minor adverse impacts on archaeological sites and submerged resources from

possible illegal collection and vandalism, similar to Alternative A. Closure of some areas and provisions for monitoring would lessen the likelihood of adverse effects related to PWC use. This alternative would not impact any known ethnographic or traditional use areas along the shoreline of Lake of the Arbuckles. Cumulative impacts on archaeological and submerged cultural resources that are readily accessible could be minor to moderately adverse, as a result of the number of visitors and the potential for illegal collection or destruction. This alternative would not result in an impairment of cultural or ethnographic resources.

**Alternative C: Reinstate PWC Use as Previously Managed Prior to November 2002, Under a Special Regulation, But Limit Use Areas.**

As described in the CHIC EA (NPS, 2003), reinstating PWC use within CHIC could have minor adverse impacts on archaeological sites and submerged resources from possible illegal collection and vandalism, similar to Alternative A. Closure of some areas and provisions for monitoring would lessen the likelihood of adverse effects related to PWC use. This alternative would not impact any known ethnographic or traditional use areas along the shoreline of Lake of the Arbuckles. Cumulative impacts on archaeological and submerged cultural resources that are readily accessible could be minor to moderately adverse, as a result of the number of visitors and the potential for illegal collection or destruction. This alternative would not result in an impairment of cultural or ethnographic resources.

**Alternative D: No-Action Alternative—Continue PWC Ban.** No impacts to cultural or ethnographic resources from PWC would occur within CHIC if the ban continued.

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## **2.6 ECONOMIC ACTIVITY IN THE SURROUNDING COMMUNITIES**

CHIC is located on the south side of the city of Sulphur, Murray County, Oklahoma. The economy of Sulphur is diverse, with agriculture, ranching, industry (including oil-related industries), education, services, and tourism/recreation. The city of Davis, approximately 9 miles from Sulphur, also provides tourist services for CHIC, although its affiliation with Turner Falls Park allows for a diversification of tourism-related income. Oklahoma City, located

85 miles to the north, is the largest population center within 100 miles.

No businesses that sell, rent, or service PWC were identified near Sulphur. According to NPS staff, several storage facilities in Murray County store PWC for local owners.

Tourism is an important part of Murray County's economy. However, PWC use in CHIC is not one of the primary forms of recreation in this area. NPS estimates that PWC users accounted for approximately 30,400 out of more than 1.6 million visitors to CHIC in 2001. PWC use in the recreation area is entirely by PWC owners and dominated by visitors residing outside the local area, many of whom have made investments in vacation homes. NPS identified three PWC-related businesses in the vicinity of CHIC that may be affected by any regulation on PWC use, including firms that store PWC and sell PWC accessories.

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*NPS identified three PWC-related businesses in the vicinity of CHIC that may be directly affected by any regulation on PWC use.*

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NPS contacted businesses in the communities surrounding CHIC to solicit input on the potential impacts of PWC restrictions. Two small firms in the area provide PWC storage. NPS also identified one store in the immediate vicinity of CHIC that sells PWC accessories. Because CHIC is an important destination for water-based recreation in the region, any restrictions on PWC use in CHIC will likely have a large impact on the PWC-related revenues of these firms. However, the diversity of their revenue sources would at least partially mitigate any impacts of PWC restrictions in CHIC.

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*Because PWC users account for a very small fraction of economic activity in the region, it is very unlikely that the proposed restrictions will have any measurable incremental impacts on the region's economy.*

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In the absence of additional information, it was assumed that CHIC staff have the best available information about PWC visitation in CHIC. The park's monthly public use reports are fairly comprehensive and have provided PWC counts since October of 1999. Thus, impacts obtained using the park staff estimates are presented as the primary results. NPS based the small business analyses (see Section 5) on the data provided by the individual small businesses potentially affected by PWC restrictions in CHIC.

In addition to the businesses contacted, the proposed restrictions could also affect lodging establishments, restaurants, gas stations, and other retail stores in the area. These establishments may be affected if the proposed restrictions lead to changes in visitation to the park and surrounding area. However, because PWC users account for a very small fraction of economic activity in the region,

it is very unlikely that there will be any measurable incremental impacts on the region's economy. The estimated regional economic impacts are discussed in more detail in Section 3.

# 3

## **Economic Impact Analysis of Reinstating PWC Use in Chickasaw National Recreation Area**

Reinstating PWC use in CHIC may affect the local economy in several ways, including changes in park visitation, sales and profits of local businesses, local employment, and local and state sales tax revenue. Generally, allowing PWC use in the park is expected to increase economic activity in the areas surrounding the park. However, the incremental impacts under Alternatives A, B, and C are expected to be very small relative to the size of the local economy.

Historically, the percentage of total visitors to CHIC that used PWC has been relatively small. Prior to the November 2002 ban, it is estimated that less than 2 percent of visitors used PWC in the park. Former PWC users whose primary reason for visiting the park was not PWC use are likely to continue visiting the park under the ban. However, park visitors who had used PWC in CHIC are negatively affected by the current ban on PWC use in the park. These visitors would also potentially be positively affected by any change in PWC regulations in CHIC that reinstated PWC use. Not only are PWC users potentially affected by any change in PWC regulations, but businesses, including PWC sales and rental shops, restaurants, and other establishments that provide services to those visitors may be affected as well.

A variety of economic analyses can be conducted to provide valuable information for policy makers trying to understand the effects of alternative policies. The type of analysis that is most appropriate for examining a particular policy or action depends on the decision under consideration. In the context of examining the impacts of regulation, two of the most important types of economic analysis are economic impact analysis and benefit-cost analysis. These types of analyses are often confused because they both estimate the economic “benefits” associated with a particular policy. However, an economic impact analysis typically examines



the effect of a change in policy on the economy of a particular region, while a benefit-cost analysis focuses on the change in economic efficiency resulting from a change in policy. Economic impact analyses trace the flows of spending associated with the affected industries to identify changes in sales, income, jobs, and tax revenues resulting from a policy action and, for CHIC, are addressed in this section. Benefit-cost analysis, on the other hand, focuses primarily on changes in social welfare and is examined in Section 4. Unlike economic impact analysis studies, benefit-cost analysis includes both market and nonmarket values (Stynes, 2000).

Reinstating PWC use in CHIC is likely to have a positive economic impact on the surrounding area. The primary economic impacts associated with the PWC management alternatives are the potential increases in sales, profits, and employment of establishments providing PWC-related goods and services, hotels, restaurants, and other businesses in the Murray County, which surrounds the park, relative to baseline conditions. The incremental impact of each alternative depends in large part on the way that affected individuals and firms responded to the ban on PWC use in CHIC.<sup>1</sup> To the extent that local businesses that relied on PWC users prior to the ban were able to provide substitute products and services, they may have been able to reduce the negative impacts on their profits. In addition, although it is expected that PWC users would decrease their overall visitation to the park because of the ban, they will not necessarily stop visiting the area altogether, especially if PWC use is not their primary activity. It is also possible that visitation to CHIC by non-PWC users has increased under the ban if the absence of PWC users makes park visitation more enjoyable for this group of people, although NPS is unable to quantify this impact because of a lack of data. The more producers and consumers were able to make adjustments to mitigate the negative impacts of the ban, and the more non-PWC users increase their visitation under the ban, the

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<sup>1</sup>Because PWC were not banned in CHIC until November 2002, but the most recent data available were collected in 2001, no data regarding changes in PWC visitation or business revenues in response to the ban are available.

smaller the incremental positive impacts of reinstating PWC use in CHIC.<sup>2</sup>

Economic impact analyses tend to overstate the impacts associated with rules such as the management alternatives for PWC use in CHIC because they do not account for behavioral changes that may mitigate impacts. However, these analyses are still very important to policy makers because they provide an estimate of the impact on the local area most directly affected by the regulation. In addition to the total impacts associated with a regulatory action, the distribution of those impacts is important. Because benefit-cost and economic impact analyses have different emphases and different final results, but both provide useful information for measuring the impact of different PWC management alternatives, both types of analyses are presented in this report. This section describes an economic impact analysis of the proposed alternatives, while Section 4 presents a benefit-cost analysis.

The majority of the economic impacts are expected to be concentrated in Murray County, which surrounds the park. Thus, projected changes in economic activity are compared to the size of the county economy to place the impacts in perspective.

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### 3.1 SCENARIOS EXAMINED IN THIS REPORT

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*NPS estimates that about 30,439 visitors used PWC during 2001, accounting for about 1.89 percent of annual visitation.*

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As described in Section 2.2, PWC users accounted for a relatively small fraction of total visitation to CHIC prior to the ban in November 2002. NPS estimates that approximately 30,439 visitors used PWC during 2001, accounting for only about 1.89 percent of annual visitation to CHIC. Baseline visitation (i.e., with PWC being banned from CHIC) was projected through 2012 using a starting point of average annual visitation over 5 years, 1997 to 2001. Baseline non-PWC user visitation was then assumed to increase at a rate equal to the average of the 1990 to 2000 annual population growth rates in Murray County. Although there would be no PWC use in CHIC in 2003–2012 under baseline conditions, it was assumed that some former PWC users (50 percent) would continue to visit the CHIC region to enjoy other recreational activities.

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<sup>2</sup>A decrease in expenditures for substitute activities in the CHIC region relative to baseline conditions in response to allowing PWC use to resume would partially offset any positive regional impacts associated with Alternatives A, B, and C. There may also be reallocation of revenue among businesses.

PWC users are expected to change their visitation to CHIC in response to regulations placed on PWC use. To estimate the magnitude of the resulting economic impacts, NPS constructed scenarios for the regulatory alternatives based on the available information. For Alternative A, it is expected that PWC users who previously used PWC in the park would return because PWC use would be managed in the same way as before the 2002 ban. Under Alternative B, PWC users would be able to use their PWC in CHIC, but would be forced to pay higher user fees and observe additional no-wake zones. Thus, it is assumed that most former PWC users, but not all, will return to visit the CHIC region to use PWC. However, of those who do not, some will return to CHIC to enjoy other recreational activities or use PWC in nearby substitute areas. Under Alternative C, PWC users would have access to CHIC once again, but in addition to the stipulations of Alternative B, they would be prohibited from operating PWC in the arms of the lake and required to comply with additional safety measures. It is assumed that, under Alternative C, most former PWC users, but less than under Alternative B, would continue to visit the area for PWC use or other recreational activities. Under Alternative D, it is expected that there will be no change in visitation relative to baseline projections because management of PWC in CHIC would remain unchanged relative to current conditions.

It is assumed that people who continue to visit the CHIC area will have the same spending patterns as baseline conditions, except that some of them will resume making PWC-related purchases. It is possible that former PWC users would have continued to visit the park to engage in other summer recreational activities and would have increased expenditures on those activities, but because there is no information on the amount these users might spend, this potential spending increase is not included in the analysis. In addition, as mentioned above, non-PWC users may have increased their visitation in response to the ban on PWC. To the extent that visitation by non-PWC users has increased following the ban on PWC use, the number of non-PWC users visiting this area may decrease relative to baseline because potential increases in noise and pollution resulting from changes in PWC management in CHIC

could decrease their enjoyment of the area.<sup>3</sup> However, neither the potential increase in non-PWC visitation under baseline conditions nor the potential decrease in non-PWC visitation were included in the analysis because of uncertainties in quantifying changes in visitation for this group of people and the associated changes in expenditure.

Prior to introducing the ban on PWC at CHIC, NPS interviewed owners of local firms that provide PWC storage and sell PWC accessories regarding the expected impacts of various PWC management options on those businesses. Based on information collected from local businesses and CHIC park staff, scenarios were developed for each of the proposed regulatory alternatives. The four scenarios that were analyzed for CHIC are summarized in Table 3-1. The predicted impacts for local businesses are discussed in detail in Section 5.

NPS estimated that, in the absence of the ban, PWC use would have increased at a 1.0 percent annual rate based on historic local trends in boat registration and annual PWC launch permits (NPS, 2003). This rate is applied to an estimate of 2002 PWC use equal to 1.89 percent (the share of PWC users in 2001, the most recent year for which data are available) of average total visitation for 1997–2001 (which equals 30,439 PWC users) to project visitation for 2003–2012 in the absence of the ban. For non-PWC users, visitation to the park was assumed to be increasing at an annual rate equal to the average annual population growth rate over the last decade for the county adjacent to CHIC and the Oklahoma City metropolitan area (see Section 2.2.3). That growth rate was 0.89 percent, which is nearly equal to the national growth rate of 0.9 percent over that time period (Census Bureau, 2002). For baseline conditions, it was assumed that only 50 percent of the visitors no longer using PWC in CHIC as a result of the ban would continue to visit the local area for alternative recreation purposes because of the lack of alternative PWC recreation areas close to CHIC.

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<sup>3</sup>This could result from an increase in the number of visitor-days for current non-PWC users and/or visitation by people who did not previously travel to the park.

**Table 3-1. Assumptions Used in Analyzing Economic Impacts of CHIC Regulatory Alternatives for PWC Use**

	Alternative A	Alternative B	Alternative C	Alternative D
Annual percentage change in the number of visitors using PWC in CHIC that would have occurred in the absence of a ban <sup>a</sup>	1.0%	1.0%	1.0%	NA
Baseline annual percentage change in non-PWC user visitation to CHIC <sup>b</sup>	0.89%	0.89%	0.89%	0.89%
Percentage of visitors who used PWC in CHIC prior to the ban who are expected to continue visiting the park for other activities <sup>c</sup>	NA	NA	NA	50%
Percentage of visitors using PWC in CHIC prior to ban who will resume PWC use in CHIC as a result of reinstatement <sup>c</sup>	100%	90%	80%	NA
Percentage of visitors storing PWC for use in CHIC prior to ban who will resume renting PWC for use in CHIC as a result of reinstatement <sup>c</sup>	100%	90%	80%	NA
Percentage of visitors purchasing PWC equipment in the CHIC region prior to ban who will continue to purchase PWC in the CHIC region <sup>c</sup>	100%	90%	80%	NA

<sup>a</sup> National Park Service (NPS). 2003. Chickasaw National Recreation Area Personal Watercraft Use Environmental Assessment. Washington, DC: National Park Service.

<sup>b</sup> U.S. Bureau of the Census (Census Bureau). 2002. "County and City Data Book: 2000." <<http://www.census.gov/prod/www/ccdb.html>>. As obtained in August 2002.

<sup>c</sup> NPS estimates.

It was assumed that PWC visitation would increase to 100 percent of pre-ban levels under Alternative A, 90 percent under Alternative B, and 80 percent under Alternative C. Revenues from PWC accessory sales and storage are assumed to increase proportionately to the estimated visitation increases under each alternative. The assumed increases in visitation and revenue are based on the distance between CHIC and other areas suitable for PWC use, as well as predictions made by local businesses about the effect of a PWC ban on their sales of PWC-related goods and services. The large expected percentage changes in revenue from PWC sales are attributable to the fact that most customers in the local shops historically made PWC-related purchases associated primarily with use at CHIC. As a result, these customers are expected to resume buying from the local shops only if the ban on PWC is lifted.

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*It was assumed that PWC visitation and revenues from PWC-related purchases would increase to 100 percent of pre-ban levels under Alternative A, 90 percent under Alternative B, and 80 percent under Alternative C. Visitation and PWC-related revenue would remain unchanged under Alternative D.*

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Visitation and PWC-related revenue would remain unchanged under Alternative D because that alternative maintains baseline conditions.

The scenarios outlined in Table 3-1 are used in Section 3.2 to provide estimates of potential economic impacts resulting from reinstating PWC use in CHIC under Alternative A, B, or C. No economic impacts are expected to result from choosing Alternative D. The fewer former PWC users who would have continued to visit CHIC to engage in alternative activities under the ban, the larger the overall impact of reinstating PWC use, other things being equal. Thus, the overall economic impact of this regulation depends on the willingness of former PWC users who are prevented by the ban from using PWC in the park to continue visiting CHIC to engage in alternative recreational activities.

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## **3.2 ECONOMIC IMPACT OF PWC REGULATIONS ON LOCAL ECONOMIES**

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*Generally, reinstating the use of PWC in CHIC is expected to increase economic activity slightly in the areas surrounding the park.*

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The proposed regulations may affect the local economy in several ways, including changes in park visitation, sales and profits of local businesses, local employment, and local and state sales tax revenue. Generally, reinstating the use of PWC in CHIC is expected to increase economic activity slightly in the areas surrounding the park. The following sections describe the estimated economic impacts on the region where the majority of the effects from increased visitation to CHIC will be felt. In each case, the projected impacts of Alternatives A, B, and C are compared with the baseline scenario, the no-action alternative, under which the ban on PWC would be upheld, and there would be no impacts compared with current conditions.

### **3.2.1 Effect of Management Alternatives on CHIC Visitation**

Alternatives A, B, and C are expected to lead to an increase in the number of visitor-days spent in CHIC compared with the projected baseline, as shown in Table 3-2. This anticipated increase in the number of visitor-days is primarily due to the expectation that the majority of people who visited to use their PWC prior to the ban will now return to the park because PWC use has been reinstated. The actual increase in park visitation depends on several factors.

**Table 3-2. Incremental CHIC Visitation under Regulation Relative to Baseline Conditions<sup>a</sup>**

Year	Alternative A			Alternative B			Alternative C		
	PWC Users	Non-PWC Users <sup>b</sup>	Total Visitation	PWC Users	Non-PWC Users <sup>b</sup>	Total Visitation	PWC Users <sup>b</sup>	Non-PWC Users	Total Visitation
2003	29,765	-14,883	14,883	26,789	-14,883	11,906	23,812	-19,050	4,762
2004	30,063	-14,883	15,180	27,057	-14,883	12,174	24,050	-19,240	4,810
2005	30,364	-14,883	15,481	27,327	-14,883	12,445	24,291	-19,433	4,858
2006	30,667	-14,883	15,785	27,600	-14,883	12,718	24,534	-19,627	4,907
2007	30,974	-14,883	16,091	27,877	-14,883	12,994	24,779	-19,823	4,956
2008	31,284	-14,883	16,401	28,155	-14,883	13,273	25,027	-20,022	5,005
2009	31,596	-14,883	16,714	28,437	-14,883	13,554	25,277	-20,222	5,055
2010	31,912	-14,883	17,030	28,721	-14,883	13,839	25,530	-20,424	5,106
2011	32,232	-14,883	17,349	29,008	-14,883	14,126	25,785	-20,628	5,157
2012	32,554	-14,883	17,671	29,298	-14,883	14,416	26,043	-20,834	5,209

<sup>a</sup>NPS generated these estimates using the assumptions in Table 3-1.

<sup>b</sup>This column includes those visitors who use PWC in the park prior to implementation of a ban on PWC use in CHIC and who would resume PWC use in the park if it were authorized under Alternative A, B, or C. It includes both former PWC users who were assumed to visit the park for other activities during the ban (who are recategorized from non-PWC users to PWC users in this table) and former PWC users who were assumed to stop visiting the park if they are unable to use their PWC (their return to visiting the park leads to a net increase in visitation relative to baseline for Alternatives A, B, and C).

Some people who previously used PWC in CHIC may choose to continue visiting the park to enjoy alternative summer activities available within CHIC, such as hiking, boating, and fishing. As mentioned earlier, visitation by non-PWC users may have increased in response to the PWC ban. Thus, if PWC are reinstated, visitation by non-PWC users is likely to decline to levels that would have occurred in the absence of the PWC ban because the reinstatement of PWC may create a less enjoyable outdoor experience for some members of this group. This decrease in visitation would partially offset the increase in PWC users. However, neither the potential increase in visitation by non-PWC users in response to the PWC ban nor the expected decrease in visitation by non-PWC users if PWC are reinstated are quantified in this analysis because the extent to which non-PWC users would decrease visitation is unknown.

### 3.2.2 Impact of Regulation on Local Business Output

As a result of the incremental increase in visitation to the CHIC area expected under Alternatives A, B, and C, there will be a corresponding increase in the value of local business output. The primary sectors affected by increases in summer visitation are the tourism sectors, including PWC storage facilities and boating accessory shops, restaurants, and retailers. As discussed in

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*No data are available concerning the increase in PWC-related business that would result from reinstatement of PWC use at CHIC. Thus, NPS used information from local businesses on their pre-ban revenues and the projected increases in PWC storage and boat accessory sales under Alternatives A, B, and C to project the total increase in revenue for these categories.*

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Appendix A, although the direct impact of an increase in visitor spending is primarily felt in these sectors, many additional sectors of the economy will be affected to some extent through secondary impacts. NPS focuses on the impacts estimated for reinstating visitation in 2003, the first year after implementation of the new regulation concerning PWC use.

Impacts in subsequent years will be similar, although they are expected to become larger over time as a result of the projected increase in incremental visitation after 2003 (see Table 3-3). The impact in all years is expected to be very small relative to the size of the local economy.

To estimate spending impacts, it is necessary to obtain spending information for use with this study's estimates on changes in visitation. No data are available concerning the increase in PWC-related business that would result from reinstatement of PWC use at CHIC. Thus, NPS used information from local businesses on their pre-ban revenues and the projected increases in PWC storage and boat accessory sales shown in Table 3-1 to project the total increase in revenue for these categories that would occur under Alternatives A, B, and C, which allow PWC to return to CHIC (i.e., assuming that PWC-related revenues would approach or reach pre-ban levels).

For categories of tourism spending other than direct spending on PWC, spending profiles were used in conjunction with estimated changes in visitation to determine the total change in park-related expenditures. The Money Generation Model (MGM2) is a simple input-output (I-O) model that NPS often uses to estimate local economic impacts associated with national park visitation, and it provides generic spending profiles for national parks (see Appendix A and the MGM2 website <<http://www.msu.edu/user/stynes/npsmgm/>> for more information about economic impact analysis using I-O models).

Based on information collected from CHIC staff, NPS assumes that half of visitors to CHIC are day users, evenly split between local day users and nonlocal day users, and half are overnight visitors staying in the area for multiple day trips to CHIC. NPS assumes that the 50 percent of visitors staying overnight are divided as follows: visitors staying in hotels outside the park, 29 percent; visitors camping in the park, 15 percent; and visitors camping outside the park, 6



percent. Table 3-3 provides the spending information available for each of the above mentioned visitor types to show the range of spending values estimated within this category. Only categories with positive average expenditures for these categories of visitors are included in the table. For this analysis, the medium<sup>4</sup> estimate was used for all of the spending categories analyzed. Because there is no spending category included that represents boat rentals, purchases, service, or storage, it was assumed that the spending estimates from MGM2 are in addition to the directly PWC-related expenditures described above.

To estimate the direct impact on CHIC business revenues, NPS calculated the increase in the number of parties visiting CHIC using data on party sizes and projected changes in visitation from Section 2.<sup>5</sup> NPS then multiplied the increase in the number of parties visiting the CHIC region by their estimated spending in each category for scenarios developed under each alternative. These scenarios are described in detail in Section 3.1. The increase in the number of PWC users to the area will directly increase the revenues of the PWC storage facilities and boat accessory shops as well as the revenues of hotels, campgrounds, restaurants and other stores patronized by PWC users.

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<sup>4</sup>MGM2 provides spending estimates that they classify as low, medium, and high expenditures.

<sup>5</sup>Although the average party sizes of PWC users and people on day trips in general in CHIC may differ from the default party size of 2.5 assumed by MGM2 for day trips, the number chosen for group size does not affect results as long as spending per person is proportional. Increasing the group size in the model would have no effect on impact calculations as long as the number of groups decreased and spending per group increased proportionately.

**Table 3-3. Generic Spending Profiles for Visitors on Day Trips to National Parks (2001\$)<sup>a</sup>**

	Spending per Party		
	Low	Medium	High
<b><i>Local Day User</i></b>			
Restaurants and bars	\$8.64	\$12.35	\$16.05
Groceries/take-out	\$4.33	\$6.19	\$8.04
Gas and oil	\$3.37	\$4.82	\$6.27
Other vehicle expenses	\$0.36	\$0.52	\$0.67
Admissions and fees	\$2.94	\$4.21	\$5.47
Clothing	\$0.69	\$0.98	\$1.28
Sporting goods	\$0.70	\$1.00	\$1.29
Souvenirs and other expenses	\$4.68	\$6.68	\$8.69
<b>Total</b>	<b>\$25.72</b>	<b>\$36.74</b>	<b>\$47.76</b>
<b><i>Nonlocal Day User</i></b>			
Restaurants and bars	\$11.52	\$16.46	\$21.40
Groceries/take-out	\$4.33	\$6.19	\$8.04
Gas and oil	\$6.75	\$9.64	\$12.53
Other vehicle expenses	\$0.54	\$0.78	\$1.01
Local Transportation	\$0.18	\$0.26	\$0.33
Admissions and fees	\$5.15	\$7.36	\$9.57
Clothing	\$1.38	\$1.96	\$2.55
Sporting goods	\$0.70	\$1.00	\$1.29
Souvenirs and other expenses	\$6.48	\$9.26	\$12.03
<b>Total</b>	<b>\$37.03</b>	<b>\$52.90</b>	<b>\$68.77</b>
<b><i>Camping Inside the Park</i></b>			
Camping Fees	\$11.27	\$16.09	\$20.92
Restaurants and bars	\$7.20	\$10.29	\$13.38
Groceries/take-out	\$9.38	\$13.40	\$17.42
Gas and oil	\$7.42	\$10.61	\$13.79
Other vehicle expenses	\$0.54	\$0.78	\$1.01
Local Transportation	\$0.18	\$0.26	\$0.33
Admissions and fees	\$4.42	\$6.31	\$8.20
Clothing	\$2.06	\$2.95	\$3.83
Sporting goods	\$0.70	\$1.00	\$1.29
Souvenirs and other expenses	\$4.32	\$6.17	\$8.02
<b>Total</b>	<b>\$47.49</b>	<b>\$67.85</b>	<b>\$88.20</b>
<b><i>Backcountry Campers</i></b>			
Motel, hotel cabin or B&B	\$3.40	\$4.86	\$6.32
Camping Fees	\$1.51	\$2.16	\$2.81
Restaurants and bars	\$4.37	\$6.25	\$8.12
Groceries/take-out	\$3.14	\$4.48	\$5.83
Gas and oil	\$4.73	\$6.76	\$8.78
Other vehicle expenses	\$0.33	\$0.47	\$0.61

(continued)

**Table 3-3. Generic Spending Profiles for Visitors on Day Trips to National Parks (2001\$)<sup>a</sup>**

	Spending per Party		
	Low	Medium	High
Admissions and fees	\$2.48	\$3.54	\$4.60
Clothing	\$0.65	\$0.92	\$1.20
Sporting goods	\$1.73	\$2.47	\$3.21
Souvenirs and other expenses	\$4.58	\$6.54	\$8.50
<b>Total</b>	<b>\$26.91</b>	<b>\$38.45</b>	<b>\$49.98</b>
<b><i>Motel Outside the Park</i></b>			
Motel, hotel cabin or B&B	\$56.33	\$80.47	\$104.61
Restaurants and bars	\$27.37	\$39.10	\$50.83
Groceries/take-out	\$7.22	\$10.31	\$13.40
Gas and oil	\$6.07	\$8.68	\$11.28
Other vehicle expenses	\$1.09	\$1.55	\$2.02
Local Transportation	\$0.36	\$0.51	\$0.67
Admissions and fees	\$8.83	\$12.62	\$16.41
Clothing	\$4.13	\$5.89	\$7.66
Sporting goods	\$0.70	\$1.00	\$1.29
Souvenirs and other expenses	\$8.64	\$12.34	\$16.04
<b>Total</b>	<b>\$120.73</b>	<b>\$172.48</b>	<b>\$224.22</b>
<b><i>Camping Outside the Park</i></b>			
Camping Fees	\$15.49	\$22.13	\$28.77
Restaurants and bars	\$8.64	\$12.35	\$16.05
Groceries/take-out	\$6.49	\$9.28	\$12.06
Gas and oil	\$7.42	\$10.61	\$13.79
Other vehicle expenses	\$0.54	\$0.78	\$1.01
Local Transportation	\$0.18	\$0.26	\$0.33
Admissions and fees	\$9.57	\$13.67	\$17.77
Clothing	\$4.13	\$5.89	\$7.66
Sporting goods	\$0.70	\$1.00	\$1.29
Souvenirs and other expenses	\$8.64	\$12.34	\$16.04
<b>Total</b>	<b>\$61.81</b>	<b>\$88.30</b>	<b>\$114.79</b>

<sup>a</sup>These values are based on the average expenditures per party for visitors to national parks. However, the number of people per party assumed by MGM2 may differ between visitor segments.

Source: Money Generation Model—Version 2 (MGM2). 2002. <<http://www.msu.edu/user/stynes/npsmgm/>>. As obtained July 2002.

Table 3-4 provides estimates for each alternative of the direct changes in revenues caused by a change in visitation based on the generic spending profiles for national parks and the information provided by local businesses. It was assumed that revenue would be unchanged relative to baseline under Alternative D. For Alternative A, PWC equipment sales revenue is estimated to increase by \$262,170 relative to the baseline estimate, while PWC

**Table 3-4. First-Year Direct Impact of PWC Reinstatement on Business Revenues in CHIC Region Relative to Baseline (2001\$)<sup>a,b</sup>**

	Alternative A	Alternative B	Alternative C
PWC storage	\$36,210	\$32,590	\$28,970
PWC equipment sales	\$262,170	\$235,950	\$209,730
Motel, hotel, cabin, or B&B	\$57,880	\$46,310	\$18,520
Camping fees	\$9,280	\$7,430	\$2,970
Restaurants and bars	\$76,670	\$61,340	\$24,540
Groceries/take-out	\$32,190	\$25,750	\$10,300
Gas and oil	\$33,290	\$26,630	\$10,650
Other vehicle expenses	\$3,450	\$2,760	\$1,100
Local transportation	\$890	\$710	\$29,250
Admissions and fees	\$30,680	\$24,540	\$9,820
Clothing	\$10,600	\$8,480	\$3,390
Sporting goods	\$4,190	\$3,360	\$1,350
Souvenirs and other retail	\$36,730	\$29,390	\$11,760
Total	\$594,230	\$505,240	\$362,350

<sup>a</sup>All impacts were rounded to the nearest \$10. Columns may not sum to totals due to rounding.

<sup>b</sup>NPS generated these estimates using the MGM2 model (MGM2, 2002).

<sup>c</sup>Based on information provided by CHIC staff, almost all visits to the park are day trips. Thus, NPS assumed that there were no visitors to the park staying overnight as part of a multiple day trip to the park.

storage revenue is expected to increase by \$36,210 relative to the baseline estimate. Under Alternative B, NPS estimated that PWC equipment sales revenue and PWC storage revenue would increase by \$235,950 and \$32,590, respectively, relative to the baseline. These figures drop to \$209,730 and \$28,970, respectively, under Alternative C.<sup>6</sup>

For the other spending categories (those that are included in MGM2), the total change in expenditures was calculated by multiplying the change in number of parties of each type (i.e., local day users and nonlocal day users) by the average expenditure per party for that type of visitor for each expenditure category.

As shown in Table 3-4, the largest direct impact is on PWC equipment sales, which are expected to absorb more than half of the estimated revenue increases regardless of the alternative chosen, followed by restaurants, lodging, souvenirs, PWC storage, gas,

<sup>6</sup>Estimated impacts on PWC rentals, sales, and service are derived from interview data collected from local firms. See Section 5 for additional information.

groceries, admissions, clothing, camping, sporting goods, other vehicle expenses and local transportation.

Note that the estimated increases in revenue in Table 3-4 overstate the true direct gains to the region because part of the sales value in the groceries/take-out, gas and oil, clothing, sporting goods, and souvenirs/retail categories goes to individuals and firms outside of the region and thus cannot be considered a gain to the CHIC region. Using these changes in revenues as inputs into MGM2, NPS estimated the total regional impacts on output. As discussed in Appendix A, only the gain of the retail markup in the retail sector can be included as an increase in regional output for the local area. This explains why the direct effect on the region estimated by MGM2 (reported in Table 3-5) is smaller than the change in revenues provided as input.

**Table 3-5. First-Year Total Impacts on Value of Output for CHIC Region (2001\$)<sup>a,b</sup>**

	Alternative A	Alternative B	Alternative C
Direct effect	\$381,900	\$320,070	\$192,060
Total impact	\$544,850	\$456,210	\$271,940

<sup>a</sup>All impacts were rounded to the nearest \$10. Columns may not sum to totals due to rounding.

<sup>b</sup>NPS generated these estimates using the MGM2 model (MGM2, 2002).

The impacts of PWC regulation in CHIC on regional output are estimated to be about 0.2 percent of local personal income under Alternative A, the alternative with the largest impacts.

In addition to the direct effect of the regulation on the regional economy, the indirect and induced effects (ripple effects on input suppliers and from changes in household income, respectively) are estimated (see Appendix A). The multipliers used for this analysis are those provided in MGM2 for a typical small metropolitan area. Table 3-5 also summarizes the total impacts on the value of output for businesses in the CHIC region. In this case, the multiplier effects are moderate. The total impact is about 40 percent larger than the direct effect. The total impact estimated for the three alternatives varies from \$271,940 to \$544,850, depending on the PWC regulatory alternative. The level of personal income in Murray County was about \$222 million in 2000 (BEA, 2002), or nearly \$229 million when converted to 2001 dollars. Thus, the economic impact of PWC regulation in CHIC on regional output is estimated to be only about 0.2 percent of local personal income under Alternative A, the alternative with the largest positive impacts.

### 3.2.3 Change in Value Added

Another measure of the impact on the local economy is the change in value added as a result of the regulation. Value added is the amount of dollar value contributed to a product at each stage of its production. It is calculated at each stage by subtracting the costs of intermediate goods from the value of the final good to avoid double-counting the value of intermediate goods. It will be a smaller value than output because it excludes the value of intermediate goods, whereas output measures do not exclude all intermediate goods. The output measure only excludes the cost of goods produced in other regions resold by wholesalers or retailers. To calculate these values for CHIC, the MGM2 data for value added as a share of total output in each sector were applied to the estimated changes in local output presented in Table 3-5 to get the direct effect on value added by sector. The MGM2 multiplier for value added in each sector was then applied to estimate the total impact. Table 3-6 provides the total change in value added for the local region as a result of the proposed regulations.

**Table 3-6. First-Year Total Impacts on Value Added for CHIC Region (2001\$)<sup>a,b</sup>**

	Alternative A	Alternative B	Alternative C
Direct effect	\$189,300	\$158,650	\$95,200
Total impact	\$337,450	\$284,360	\$177,110

<sup>a</sup>All impacts were rounded to the nearest \$10. Columns may not sum to totals due to rounding.

<sup>b</sup>NPS generated these estimates using the MGM2 model (MGM2, 2002).

### 3.2.4 Effect on Personal Income

Personal income is a portion of value added in which policy makers are commonly interested. It comprises employee compensation and proprietor income. Table 3-7 shows how labor income in the CHIC region changes as a result of the alternatives reinstating PWC use. This value is smaller than value added because it includes only a subset of the components of value added, but it is often useful to break value added down in this way to estimate the effect on regional personal income. Similar to value added, the direct effect of this component is calculated using the MGM2 data for personal income as a share of output in each sector. The total effect is then

**Table 3-7. First-Year Total Impacts on Personal Income for CHIC Region (2001\$)<sup>a,b</sup>**

	Alternative A	Alternative B	Alternative C
Direct effect	\$124,570	\$104,400	\$62,640
Total impact	\$216,800	\$182,890	\$114,720

<sup>a</sup>All impacts were rounded to the nearest \$10. Columns may not sum to totals due to rounding.

<sup>b</sup>NPS generated these estimates using the MGM2 model (MGM2, 2002).

calculated by multiplying the direct effect by the personal income multiplier included in MGM2 for each sector.

### 3.2.5 Change in Employment

Another effect of the proposed regulations is to increase employment in the sectors affected by the rules. These changes are calculated by MGM2 based on ratios of sales to employment for the affected industries in the CHIC area. As a result of the increase in sales anticipated under this regulation, companies will need additional employees. The estimated increase in employment ranges from 5.4 to 13.3 employees, depending on the management alternative considered. These values are calculated based on MGM2 data on the number of employees per million dollars of output in each industry. Estimated changes in the number of employees are therefore equal to the change in output times the number of employees required per unit of output. Table 3-8 summarizes the results of the employment analysis.

**Table 3-8. First-Year Total Change in Employment for CHIC Region (Number of Jobs)<sup>a</sup>**

	Alternative A	Alternative B	Alternative C
Direct effect	10.7	9.0	5.4
Total impact	13.3	11.2	6.7

<sup>a</sup>NPS generated these estimates using the MGM2 model (MGM2, 2002).

### 3.2.6 Change in Tax Revenue

In addition to impacts on the local businesses operating near CHIC, there is also an impact on the state and local governments. The middle-range income tax rate for Oklahoma is 4 percent, and Murray County has an additional local income tax of 5 percent. The state sales tax rate is 5 percent. There is no local sales tax.

State income taxes from affected businesses are estimated to increase between \$2,240 and \$4,450 in the three scenarios analyzed, as presented in Table 3-9, based on estimated changes in business revenue. In addition, local income tax receipts are expected to increase between \$2,280 and \$5,610. State sales tax receipts are predicted to increase by \$15,000 to \$26,740.

**Table 3-9. First-Year Change in State and Local Sales Tax Revenue<sup>a,b</sup>**

	Alternative A	Alternative B	Alternative C
State			
Income Tax	\$4,450	\$3,730	\$2,240
Sales Tax	\$26,740	\$22,740	\$15,000
Local			
Income Tax	\$5,610	\$4,700	\$2,820
Sales Tax	\$0	\$0	\$0

<sup>a</sup>All impacts were rounded to the nearest \$10. Columns may not sum to totals due to rounding.

<sup>b</sup>NPS generated these estimates using the MGM2 model (MGM2, 2002).

### 3.2.7 Summary

Several different measures of the economic impacts resulting from reinstating PWC use in CHIC are presented in this section. Each measure provides slightly different information about the expected economic effects on the region. Income and value added are generally considered the best measures of economic impacts because sales and job estimates can be misleading. Sales or output measures include spending on inputs purchased outside the region, and job estimates are distorted by part-time and seasonal positions because the data available are on jobs, not on full-time equivalents. In addition, the wage rates across different jobs vary widely across industries (Stynes, 2000). Income and value-added measures both avoid these difficulties and concentrate on changes that affect only the CHIC region.



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*NPS estimates that the total impact on regional output is \$594,230, \$456,210, and \$271,940, for Alternatives A, B, and C, respectively. These gains are very small compared to the size of the regional economy, even under Alternative A, the alternative with the largest impacts.*

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In the analysis presented here, NPS estimates that the total impact of the proposed alternatives for regulating PWC use in CHIC on regional output is \$594,230, \$456,210, and \$271,940 for Alternatives A, B, and C, respectively, in the first year after rule implementation (see Table 3-5). Under Alternative D, the no-action alternative, there would be no incremental impacts. The gains associated with Alternatives A, B, and C are very small compared to the size of the regional economy, even under Alternative A (the alternative with the largest impacts). In 2000, total personal income in Murray County, where CHIC is located, was approximately \$222 million (Bureau of Economic Analysis, 2002), or \$229 million in 2001 dollars. Thus, even if all revenues related to PWC use in CHIC were to return to the regional economy, the impact would be very small (regional output would increase by only 0.2 percent of personal income), although some businesses and communities in the county that rely heavily on PWC users may experience localized impacts. The low economic impacts are logical considering the relatively small expected change in the number of PWC users in the region relative to the approximately 1.6 million annual visitors to CHIC alone. While PWC use has historically been an important part of boating activity on Lake of the Arbuckles, PWC visitors made up a small share of total visitors to the region prior to the ban.

### **3.2.8 Uncertainty**

A number of factors will affect the regional economic impacts associated with the proposed alternatives. Some of the main sources of uncertainty include the following:

Although NPS has provided its best estimate of the regional economic impacts associated with the proposed alternatives, numerous sources of uncertainty may influence the results.

- The projections of PWC use in the absence of the ban were based on an estimate of PWC use in 2001 as a percentage of total visitation and the local trends in boat registrations and annual PWC use permits. To the extent that PWC users accounted for an unusually small or large proportion of total visitation in 2001, visitation by PWC users in the absence of the ban may be understated or overstated. In addition, the trends in local population and PWC ownership may not constitute a good proxy for the future annual change in visitation to CHIC by PWC users. It may understate or overstate the actual change in CHIC PWC use that would occur in future years under baseline conditions. The uncertainties associated with the baseline projections are discussed in further detail in Section 2.2.

- The proportion of PWC users who would have continued to visit the park under the ban on PWC use is unknown. As a result, the incremental increase in visitation resulting from reinstating PWC use may be higher or lower than calculated in this analysis.
- Non-PWC users may have increased visitation following the ban. To the extent that they would reduce their visitation relative to the baseline if PWC use were reinstated, the positive impacts to local businesses of reinstating PWC use would be partially offset. Because insufficient information regarding this effect was available, this potential impact was not quantified in the analysis, which will tend to overstate the regional impacts.
- EPA regulations phasing in emissions reductions from new PWC over the period from 1996 to 2006 (see Section 2.2.4) are expected to increase the cost of producing PWC over time. The corresponding increase in market price of PWC may lead to a reduction in sales that would reduce PWC use in CHIC in the absence of the ban relative to the projected levels. This would tend to reduce the incremental benefits attributable to NPS regulations reinstating PWC use in future years. However, cost increases due to these regulations are probably captured in the current baseline to some degree because the rule has already required some reduction in emissions.
- Generic spending patterns and multipliers from MGM2 were used to represent economic activity in the CHIC area. To the extent that spending patterns of PWC users in CHIC differ from the generic spending of local and nonlocal day users and/or the generic multipliers for a national park in a small metropolitan area differ from the multipliers for the CHIC region, the impacts may be understated or overstated.
- In addition, the general uncertainties and caveats are associated with the use of I-O models. These factors are described in further detail in Appendix A.

# 4

## Benefit-Cost Analysis of the Alternative Regulations

The purpose of benefit-cost analysis is to evaluate the social welfare implications of a proposed action—in this case the regulation of PWC use in national parks. The impacts of this action, both the benefits and costs, will ultimately be experienced as changes in well-being for households/individuals.

The purpose of benefit-cost analysis is to evaluate the social welfare implications of a proposed action—in this case the regulation of PWC use in national parks. It examines whether the reallocation of society's resources resulting from the action promotes efficiency. That is, it assesses whether the action results in benefits (gains in social welfare) greater than the associated costs to society (losses in social welfare).

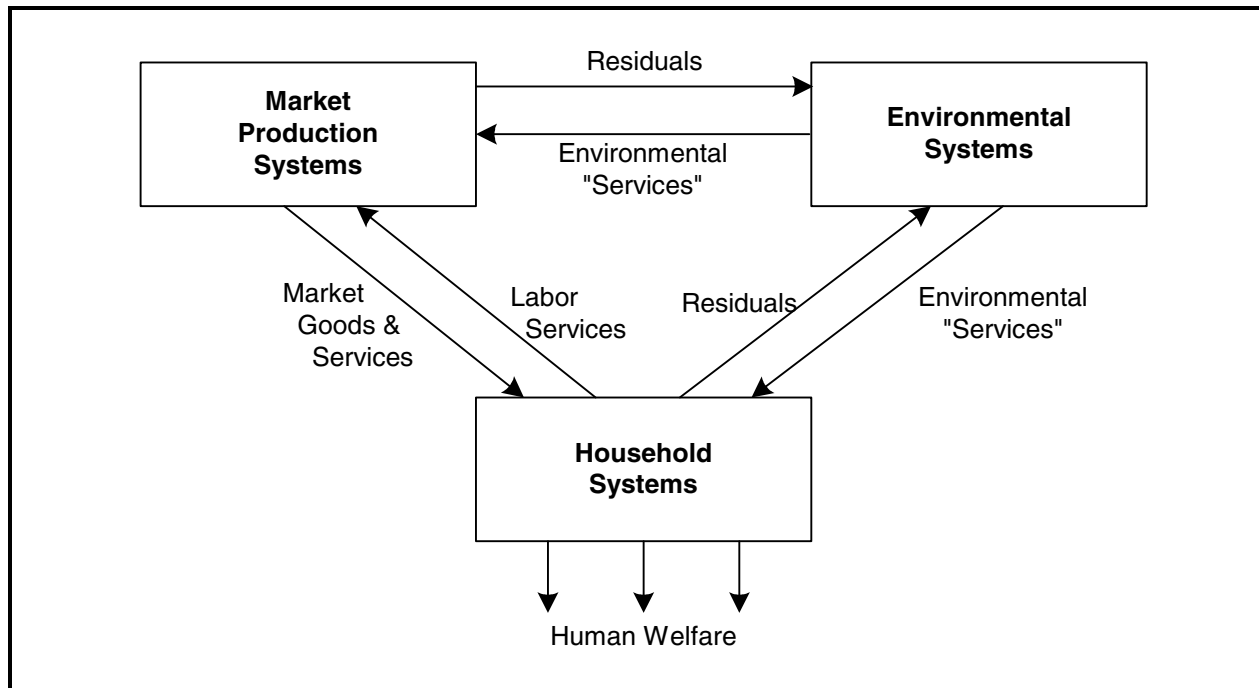
Section 4.1 provides a general outline of the approach to benefit-cost analysis and the possible benefits and costs of PWC regulations in national parks. Section 4.2 presents the analysis for CHIC specifically.

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### 4.1 CONCEPTUAL BASIS FOR BENEFIT-COST ANALYSIS OF PWC RESTRICTIONS IN NATIONAL PARKS

According to the conceptual underpinnings of benefit-cost analysis, all social welfare impacts ultimately accrue to individuals. This is represented in Figure 4-1, which depicts flows of goods, services, and residuals among three major systems: market production, household, and the environment. Because these systems are closely interconnected, actions taken to reduce releases of harmful residuals (e.g., chemicals or noise pollution) to the environment will potentially reverberate throughout all of these systems.

**Figure 4-1. Interrelationship Among Market, Environmental, and Household Systems and Social Welfare**



Nevertheless, the impacts of these actions, both the benefits and costs, will ultimately be experienced as changes in well-being for households/individuals. As a result, identifying and measuring benefits and costs must focus on these changes in well-being.

The conceptual framework depicted in Figure 4-1 therefore provides a basis for assessing the benefits and costs of PWC regulations in national parks. In these cases, the most direct impact will be on households that use PWC, whose recreational opportunities will be affected by the regulations. This will result in direct changes in welfare for these households. In addition, the resulting changes in the behavior of these households are likely to affect environmental systems and market systems. Effects on these systems will indirectly affect the welfare of other households. For example, the park environment will be improved or degraded, and this change will affect the "services" (primarily recreation-related) that the park provides to other households and individuals in society. Businesses that cater to non-PWC visitors may also be affected if the number of people visiting the park changes. On the other hand, the resulting changes in the market demand for PWC-related goods and services

will have impacts for those who own or work for establishments supplying these services.

These types of direct and indirect impacts are identified and evaluated as part of this benefit-cost analysis. Specifically, in Section 4.2, NPS estimates the incremental benefits and costs relative to the baseline.

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*In certain instances, welfare changes are directly the result of monetary gains or losses and can therefore be thought of as being equivalent to these gains or losses. In other instances, welfare changes are not directly associated with pecuniary gains or losses.*

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Estimating the value of benefits and costs also requires methods for expressing welfare changes in monetary terms. In certain instances, welfare changes are directly the result of monetary gains or losses and can therefore be thought of as being equivalent to these gains or losses. For example, welfare gains or losses to PWC sales shops due to changes in demand for their services can be reasonably measured as their resulting net change in income. In other instances, welfare changes are not directly associated with pecuniary gains or losses. Such “nonmarket” changes might, for example, include the welfare gains or losses from improved or degraded recreational opportunities in a park. In these cases, a surrogate measure of gains or losses must be used; willingness to pay (WTP) is such a surrogate. Economists and other practitioners of benefit-cost analysis generally accept WTP as the conceptually correct measure for valuing changes in individuals’ welfare. WTP represents the maximum amount of money that an individual would be willing to forgo to acquire a specified change. As such, it is the monetary equivalent of the welfare gain from the change.

Using this conceptual framework for identifying, measuring, and valuing changes in societal welfare, the remainder of this section and Appendix B provide a more detailed discussion of

- the types of benefits and costs associated with PWC restrictions in national parks and
- the approaches used in measuring these benefits and costs.

#### **4.1.1 Social Costs of PWC Use**

Use of PWC in national parks may be associated with a number of negative impacts on environmental resources and ecosystems. The extent to which adverse impacts will be realized is a function of several factors, including the level of use, the technology of the machines being used, and the extent to which users remain in designated areas. One result of any negative impacts that occur is that they impose welfare losses on individuals who value the parks’

environmental systems. The negative impacts of PWC use on other people are also referred to as negative externalities. If PWC do generate negative externalities, then this represents a market failure. The private cost of using a PWC (the cost to the individual PWC user) will be lower than the social cost of PWC use (where the social cost of PWC use includes both the cost to the PWC user plus the costs to others that result from the negative externalities associated with PWC use). Because PWC users do not have to pay the full social cost of using a PWC and instead only pay the lower, private cost, PWC use will be maintained at a higher level than socially optimal in the absence of regulation.

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*Because PWC users do not have to pay the full social cost of using a PWC and instead only pay the lower, private cost, PWC use will be maintained at a higher level than socially optimal in the absence of regulation.*

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The costs of allowing PWC in national parks can therefore be thought of and measured as the increase in these incremental losses to society. In addition, use of PWC can negatively affect society in ways that are not directly related to the environment; therefore, the incremental costs of PWC regulations must also include increases in these nonenvironmental losses.

Table 4-1 provides a broad classification of the types of environmental and nonenvironmental impacts associated with PWC use in national parks. In this section, this classification is used to more completely identify, categorize, and describe the full range of potential benefits associated with PWC restrictions in national parks in general. In Section 4.2.3, this framework is then used to specifically describe the costs that are expected to result from the management alternatives for CHIC.

**Table 4-1. Classification of Potential Negative Impacts from PWC Use in National Parks**

Impact Categories	Examples of Impacts
Environmental impacts	
Aesthetic	Noise, visibility, odor
Human health	Through impacts to air and water quality
Ecosystems	Loss of or damage to habitat and wildlife
Nonenvironmental impacts	
Infrastructure	Costs of monitoring, maintenance, and law enforcement
Human safety	Accidents
Cultural, historical, and archeological	Physical damages

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*The value that people place on a particular recreational activity depends strongly on the availability of substitutes. In areas where numerous areas are available for recreational activities, the value of improving environmental conditions in one of those areas will tend to be smaller.*

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### **Environmental Costs of PWC Use**

The use of PWC may have adverse impacts on air quality, natural resources (e.g., water quality, habitat), wildlife, and natural quiet. Figure 4-2 depicts the various categories of potential adverse effects to the environment through which PWC use in national parks can impose welfare losses on society.

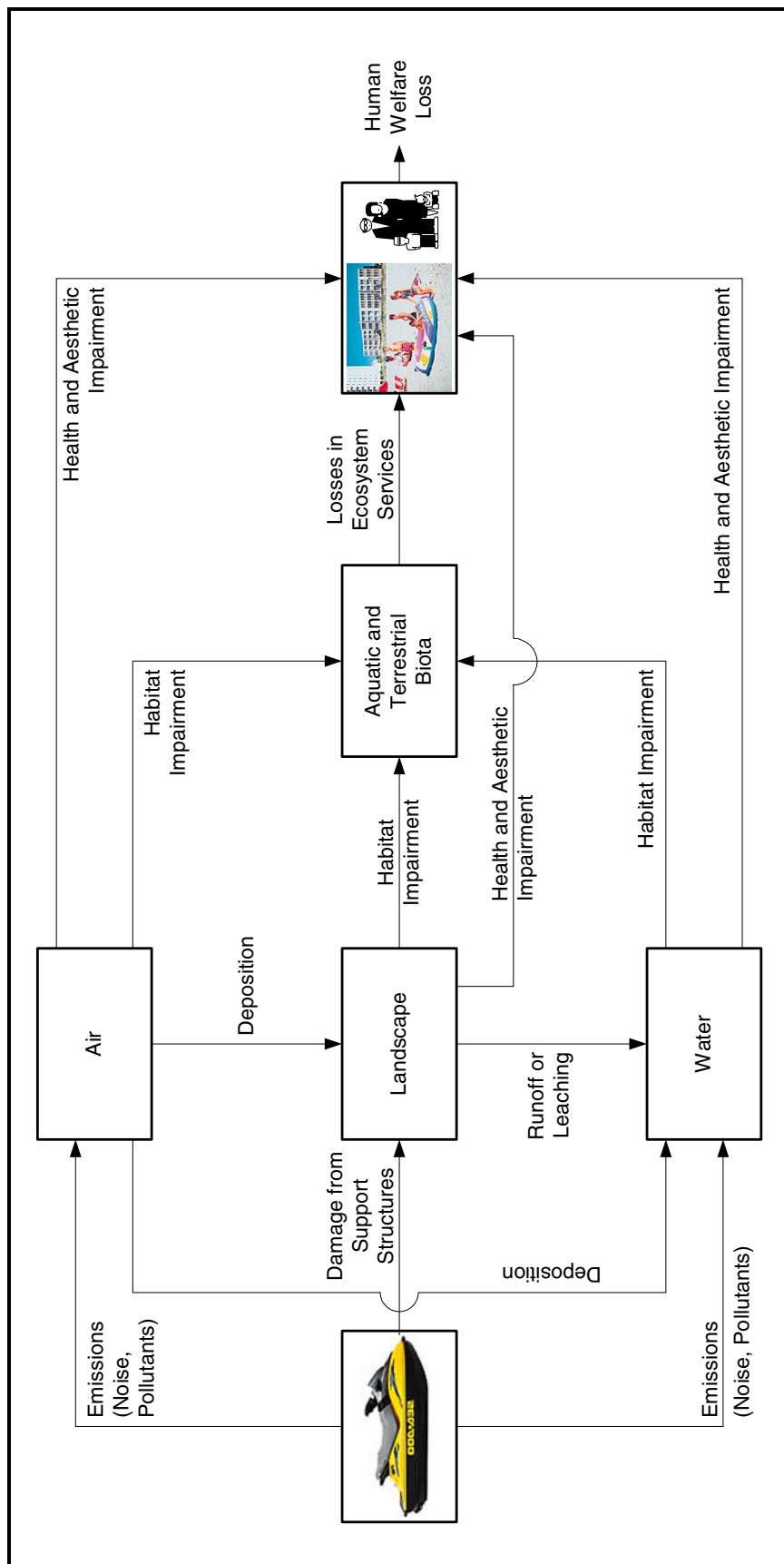
- Typical (two-stroke engine) PWC release substantial amounts of noise and pollutants into the environment. Noise from PWC impairs the natural soundscape for park visitors and has the potential to negatively affect wildlife in the park. Emissions from PWC can also negatively affect park ecosystems, human health, and visitor experiences. The three primary reasons for the potential impacts due to release of pollutants are as follows:
  - ✓ up to one-third of the fuel delivered to the engine is expelled without being burned,
  - ✓ lubricating oil is mixed with fuel and thus is expelled as part of the exhaust, and
  - ✓ the combustion process results in high emissions of air and water pollutants.

Pollutants are directly released to air and water, causing contamination of air and water resources.

As shown in Figure 4-2, all of these impacts can, directly or indirectly, lead to losses in human welfare. Therefore, from a benefit-cost perspective, those who ultimately lose from actions to allow PWC will be individuals who value the quality of the park environment. Many of those that experience losses will be park visitors whose recreational experiences are disturbed. As a point of reference, Table 4-2 reports average consumer surplus values that have been estimated for common non-PWC-related summer recreation activities from a study by Rosenberger and Loomis (2000). These are the types of recreation values that may be diminished by the presence of PWC.

The value that people place on a particular recreational activity depends strongly on the availability of substitutes. In regions where numerous areas are available for recreational activities, the value of changing environmental conditions in one of those areas will tend to be smaller. The reason is that there are already many other areas where people can engage in the same activity. Unless there are unique characteristics that people value in the area where

**Figure 4-2. Routes of Environmental Damages and Human Welfare Losses from PWC Use in National Parks**





**Table 4-2. Summary of Average Recreation Values (2001\$ per Person per Day) for Selected Activities by Region<sup>a,b</sup>**

Activity	Study Location					U.S. Average
	Northeast	Southeast	Mountain	Pacific	National <sup>c</sup>	
Picnicking	59.46 (1)	40.10 (1)	39.10 (7)	79.62 (2)	16.89 (1)	45.78 (12)
Swimming	40.06 (5)	NA	NA	16.10 (1)	22.26 (1)	34.10 (7)
Hiking/backpacking	48.46 (2)	118.40 (2)	40.29 (3)	21.95 (6)	22.47 (1)	43.48 (14)
Fishing	34.06 (42)	29.87 (13)	45.75 (39)	39.96 (16)	40.12 (4)	38.62 (114)
Motor boating	56.46 (2)	NA	74.04 (2)	16.29 (1)	41.67 (1)	53.16 (6)

NA = Not available.

<sup>a</sup>All amounts were inflated using the consumer price index for recreation available from the U.S. Bureau of Labor Statistics (2002). Numbers in parentheses represent the number of observations (i.e., studies).

<sup>b</sup>These values were taken from multiple studies conducted between 1967 and 1998.

<sup>c</sup>Studies estimating nationwide values.

Source: Rosenberger, Randall, and John Loomis. 2000. "Using Meta-Analysis for Benefit Transfer: In-Sample Convergent Validity Tests of an Outdoor Recreation Database." *Water Resources Research* 36(4):1097-1107.

conditions will be improved or degraded, there will probably be relatively small benefits or costs as a result of the environmental change. On the other hand, in regions with few substitutes for the local national park that would potentially experience environmental damage as a result of the regulations, the losses to park users may be much greater.

Even individuals who are not park visitors (i.e., nonusers) can benefit from the knowledge that park resources are being protected and preserved. In other words, they may hold positive or negative "nonuse values" (i.e., a positive WTP) for protecting or degrading the park environment. These nonuse values can stem from the desire to ensure others' enjoyment (both current and future generations) or from a sense that these resources have some intrinsic value. Pearce and Moran (1994) review studies that have attempted to estimate nonuse values for the protection of unique species and ecosystems. The measurement of nonuse value remains controversial, and, in this report NPS, does not attempt to quantify the possible benefits or costs associated with nonuse values. Allowing PWC use in national parks can therefore result in losses to

both users and nonusers in a number of ways by degrading the parks' ecological resources.

Appendix B provides a detailed discussion of the nonenvironmental impacts, in particular, and how these restrictions can affect public safety in national parks and reduce the costs of operating and maintaining the infrastructure necessary to support and monitor PWC use.

#### **4.1.2 Social Benefits of PWC Use**

The primary benefits associated with allowing the use of PWC in national parks will accrue to

- PWC users, especially individuals who would otherwise not use PWC in the park as a direct result of the ban on PWC use, and
- providers of PWC-related services for park visitors.

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*After conducting an extensive review of the economics literature and consulting with the authors of existing studies, experts in recreation demand analysis at universities, and other experts, NPS was unable to locate a study that estimated the consumer surplus for a PWC trip.*

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Just as Section 4.1.1 described potential consumer surplus losses to other park visitors and the public associated with PWC use, the potential welfare gains to PWC users are measured in terms of consumer surplus. Regulations that restrict the use of PWC impose costs on PWC users. For instance, prohibiting PWC use in the park has resulted in a loss of the consumer surplus for former CHIC PWC users. Reinstating PWC use in CHIC under Alternatives B and C, which impose restrictions such as increasing age requirements and limiting the areas of the park that are open to PWC, would increase the consumer surplus of PWC users relative to baseline. A return to pre-ban PWC management practices under Alternative A, with fewer geographic restrictions, would increase the consumer surplus of PWC users slightly more than under Alternative B or C.

As with other activities, the extent of the welfare loss to an individual rider depends crucially on the availability of substitute areas to use PWC and/or to engage in other recreational activities. All else equal, individuals who have fewer substitutes for PWC use (either other places to use PWC or other activities they enjoy as much) enjoy greater consumer surplus from PWC use in a particular body of water and thus will experience a greater gain in welfare if that body of water is opened to PWC use.

After conducting an extensive review of the economics literature and consulting with the authors of existing studies, experts in recreation demand analysis at universities, and other experts, NPS

was unable to locate a study that estimated the consumer surplus associated with a PWC trip. Table 4-2 presents the results of a review of the recreation literature conducted by Rosenberger and Loomis (2000). The review found an average value of \$49.37 (1996 dollars) per person per day for riding in motor boats (with estimates ranging from \$15 to over \$65). The same study reports a value of \$26.79 (1996 dollars) per person per day (with estimates ranging from \$20 to over \$30) for off-road driving. Bhat et al. (1998) report consumer surplus estimates ranging from \$9.12 to \$54.93 for motorboating and waterskiing in different regions of the country. These estimates, along with the estimates in Table 4-2, provide a range of values for activities similar to riding PWC and provide a bound on the consumer surplus for PWC users expected from the regulations. Note that measures of net consumer surplus to PWC riders that do not account for the additional costs imposed on society by the negative externalities associated with PWC use will overstate the true net social welfare associated with the activity.

Even PWC users who do not currently visit the park may have a positive value associated with maintaining access for PWC in parks that they could potentially decide to visit in the future. These users hold an option to visit the park in the future. Restrictions on PWC access to parks would reduce or eliminate the value of that option. Thus, PWC users who do not visit the park may still experience a gain in welfare if the park allows PWC use. However, because information was lacking on the population of PWC users who may choose to visit a given park in the future and the value that they place on that option, NPS does not attempt to quantify the potential gains in option value.

An increase in PWC use at a particular park may also affect businesses that offer services to PWC users. These businesses are not directly affected by NPS regulations of PWC users (i.e., none of the regulations directly require any action from PWC dealerships, rental shops, or other businesses), but they are likely to be affected nonetheless. For example, allowing PWC use in national parks may lead to increased demand for PWC sales or rentals and decreased demand for motorboats or canoes. These shifts in demand may reallocate sales among businesses and may lead to an increase in total revenue for businesses providing tourism-related services. As described in Section 3, the local economy may also experience

ripple effects. If businesses that serve PWC users experience an increase in demand for their services, they will most likely increase their purchases of inputs from other sectors of the local economy, including labor. In addition, an increase in revenue for local firms tends to increase regional income. Increases in average household income for the region surrounding the park will also lead to increases in sales for local businesses as local households respond by purchasing more goods (see Appendix A for more detailed information on ripple effects).

Whether these indirect, or secondary, impacts should be included as a change in social welfare in the benefit-cost analysis depends on whether the change in demand or supply in the secondary market results in price changes (for details, see a benefit-cost analysis textbook such as Boardman et al. [1996]). In general, when the policy change in the primary market (PWC trips to the national park) causes prices to change in the secondary markets, the net change in social welfare from the secondary market should be included in the benefit-cost analysis. If prices do not change in the secondary market, the revenue gains or losses should not be included in the benefit-cost analysis. If the people who would have used PWC in the national park spend their money elsewhere instead, this represents a transfer from one region of the country to another or from one business to another. Although the loss in revenue may hurt the businesses located near the national park, from society's point of view this represents a transfer of income rather than a true cost to society as a whole.

Without more detailed information, it is difficult to predict with certainty whether the proposed alternatives will change prices for PWC-related sales. However, NPS believes it is quite possible that the changes in demand that would occur under these alternatives may result in price changes for PWC-related markets. Thus, losses or gains to tourism-related businesses that may be indirectly affected by the rule are included in the benefit-cost analysis.

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## **4.2 RESULTS FOR CHICKASAW NATIONAL RECREATION AREA**

Based on the approach and possible impacts outlined above, this section presents the results of the benefit-cost analysis for CHIC. The section discusses the groups most directly affected by the

alternatives for managing PWC use in the park and several scenarios for the possible levels of impacts. The benefits and costs accruing to these groups, relative to the baseline (where PWC are banned from CHIC) are then presented.

#### **4.2.1 Affected Groups**

For the purpose of this study, six major affected groups, listed in Table 4-3, have been identified:

1. PWC users, in particular those who used PWC in CHIC prior to the November 2002 ban and those who may wish to use PWC in CHIC in the future.
2. Other visitors or potential visitors who may have a different experience at the park if PWC use is reinstated in CHIC (canoeists, anglers, swimmers, hikers, boaters, and other visitors).
3. Producers of PWC services (e.g., PWC rental shops, PWC sales shops, restaurants, gas stations, hotels) in the area surrounding CHIC who may experience a change in their welfare if PWC use in the park changes.
4. Local residents of the area surrounding CHIC.
5. Producers of services to other types of summer visitors (e.g., canoe rentals or powerboat rentals) who may experience a change in their welfare related to the number of PWC users in the park.
6. The general public who may care about the natural resources in CHIC even if they do not visit the park.

The impacts on these groups under each alternative are discussed in more detail below.

**Table 4-3. Impact of Alternatives on User Groups**

User Group	Alternative A	Alternative B	Alternative C	Alternative D (No-Action Alternative)
1. PWC Users	<ul style="list-style-type: none"> <li>Consumer surplus is expected to increase as a result of lifting the ban on PWC in CHIC.</li> </ul>	<ul style="list-style-type: none"> <li>Consumer surplus is expected to increase, although somewhat less than for Alternative A because of the increased cost of PWC use.</li> </ul>	<ul style="list-style-type: none"> <li>Consumer surplus is expected to increase, although somewhat less than for Alternative B because of the additional geographical restrictions.</li> </ul>	<ul style="list-style-type: none"> <li>No change in consumer surplus.</li> </ul>
2. Other Visitors or Potential Visitors: Canoe Users, Anglers, Other Boaters, Swimmers, Hikers and Other Visitors	<ul style="list-style-type: none"> <li>Consumer surplus for current users of CHIC is expected to decrease as a result of decreased solitude, increased noise, decreased water quality, and an increase in the risk of accidents involving PWC.</li> <li>Consumer surplus is expected to decrease for potential visitors who would have visited CHIC with a ban on PWC use.</li> </ul>	<ul style="list-style-type: none"> <li>Consumer surplus for current users of CHIC is expected to decrease as a result of decreased solitude, increased noise, decreased water quality, and an increase in the risk of accidents involving PWC.</li> <li>Consumer surplus is expected to decrease for potential visitors who would have visited CHIC with a ban on PWC use, although this decrease may be slightly less than under Alternative A.</li> </ul>	<ul style="list-style-type: none"> <li>Consumer surplus for current users of CHIC is expected to decrease in a manner similar to Alternative B, although the magnitude of the decrease may be somewhat smaller because of the additional geographical restrictions on PWC.</li> <li>Consumer surplus is expected to decrease for potential visitors who would have visited CHIC with a ban on PWC use, although this decrease may be slightly less than under Alternative B.</li> </ul>	<ul style="list-style-type: none"> <li>No change in consumer surplus.</li> </ul>

(continued)

**Table 4-3. Impact of Alternatives on User Groups (continued)**

User Group	Alternative A	Alternative B	Alternative C	Alternative D (No-Action Alternative)
3. Producers of PWC Goods and Services: PWC Storage Facilities PWC Accessory Shops Other Parts of the Local Economy Providing Services to PWC Users	<ul style="list-style-type: none"> <li>PWC storage facilities are expected to experience a small increase in producer surplus.</li> <li>PWC accessory shops are expected to experience a small increase in producer surplus.</li> <li>Other parts of the local economy such as hotels, restaurants, and gas stations located near CHIC may have an increase in producer surplus.</li> </ul>	<ul style="list-style-type: none"> <li>PWC storage facilities are expected to experience a small increase in producer surplus. This increase is likely to be slightly lower than under Alternative A because of the smaller increase in demand.</li> <li>PWC accessory shops are expected to experience a small increase in producer surplus. This increase is likely to be slightly lower than under Alternative A because of the smaller increase in demand.</li> <li>Other parts of the local economy such as hotels, restaurants, and gas stations located near CHIC may have an increase in producer surplus. This increase is likely to be slightly lower than under Alternative A because of the smaller increase in demand.</li> </ul>	<ul style="list-style-type: none"> <li>PWC storage facilities are expected to experience a small increase in producer surplus. This increase is likely to be slightly lower than under Alternative B because of the smaller increase in demand.</li> <li>PWC accessory shops are expected to experience a small increase in producer surplus. This increase is likely to be slightly lower than under Alternative B because of the smaller increase in demand.</li> <li>Other parts of the local economy such as hotels, restaurants, and gas stations located near CHIC may have an increase in producer surplus. This increase is likely to be slightly lower than under Alternative B because of the smaller increase in demand.</li> </ul>	<ul style="list-style-type: none"> <li>No change in producer surplus.</li> </ul>

(continued)

**Table 4-3. Impact of Alternatives on User Groups (continued)**

User Group	Alternative A	Alternative B	Alternative C	Alternative D (No-Action Alternative)
4. Local Residents of the Area Surrounding CHIC	<ul style="list-style-type: none"> <li>Local residents who use PWC will experience an increase in welfare as a result of reinstating PWC in CHIC.</li> <li>Local residents who do not use PWC may experience a decline in welfare as a result of an increase in noise, a decline in water quality, and an increase in the risk of accidents involving PWC.</li> </ul>	<ul style="list-style-type: none"> <li>Local residents who use PWC will experience an increase in welfare as a result of reinstating PWC in CHIC.</li> <li>Local residents who do not use PWC may experience a decline in welfare as a result of an increase in noise, a decline in water quality, and an increase in the risk of accidents involving PWC.</li> </ul>	<ul style="list-style-type: none"> <li>Local residents who use PWC will experience an increase in welfare as a result of reinstating PWC in CHIC.</li> <li>Local residents who do not use PWC may experience a decline in welfare as a result of an increase in noise, a decline in water quality, and an increase in the risk of accidents involving PWC.</li> </ul>	<ul style="list-style-type: none"> <li>No change in welfare.</li> </ul>
5. Producers of Services for Visitors to CHIC who do not use PWC	<ul style="list-style-type: none"> <li>Producer surplus is expected to decrease because allowing PWC may result in a decrease in demand for other activities in CHIC, resulting in decreased demand for the provision of services related to these activities.</li> </ul>	<ul style="list-style-type: none"> <li>Producer surplus is expected to decrease because allowing PWC may result in a decrease in demand for other activities in CHIC, resulting in decreased demand for the provision of services related to these activities.</li> </ul>	<ul style="list-style-type: none"> <li>Producer surplus is expected to decrease because allowing PWC may result in a decrease in demand for other activities in CHIC, resulting in decreased demand for the provision of services related to these activities.</li> </ul>	<ul style="list-style-type: none"> <li>No change in producer surplus.</li> </ul>
6. The General Public who may Care about CHIC even if they do not Visit	<ul style="list-style-type: none"> <li>May experience a decrease in welfare as a result of diminished nonuse values resulting from decreased environmental quality.</li> </ul>	<ul style="list-style-type: none"> <li>May experience a decrease in welfare as a result of diminished nonuse values resulting from decreased environmental quality.</li> </ul>	<ul style="list-style-type: none"> <li>May experience a decrease in welfare as a result of diminished nonuse values resulting from decreased environmental quality.</li> </ul>	<ul style="list-style-type: none"> <li>No change in welfare.</li> </ul>



Alternative A, which reinstates PWC use as managed prior to the ban, has a negative effect on all user groups except for PWC users and the businesses that cater to them. NPS expects negative welfare effects for all users except PWC users, PWC-related businesses, and other businesses that provide services to PWC users. Adverse impacts of PWC on swimmers, anglers, and other users within CHIC relative to the baseline are increased under this alternative because PWC are allowed within the park's boundaries as previously managed. PWC users, PWC-related businesses, and other businesses that provide services to PWC users are expected to experience gains of consumer and producer surplus. The impact on boaters is ambiguous. Allowing PWC in the park should have negative impacts on other boaters' consumer surplus because of the increased probability of accidents between boaters and PWC users and increased noise levels. However, some boaters enjoy using PWC as part of their boating trips and may therefore experience welfare gains as a result of lifting the ban.

Alternative B, the preferred alternative, will have the same impacts as Alternative A, but the magnitude of the impact on each group discussed above will be mitigated somewhat due to the additional restrictions described in Section 1.4.

Alternative C will have the same impacts as Alternative B, but the magnitude of the impact on each group discussed above will likely be further mitigated due to the additional restrictions described in Section 1.4.

Alternative D, which continues the ban on PWC, would have no effect on any user group relative to baseline conditions.

#### **4.2.2 Scenarios**

NPS considers the baseline conditions to which the alternatives are compared to be a ban on PWC use in CHIC.

To develop estimates of the benefits and costs of the rule under each alternative, NPS used the scenarios described below. NPS considers the no-action alternative to be the baseline to which the alternatives are compared. It should be noted that under the baseline projections, park-related PWC goods and services such as storage are assumed to have declined by 100 percent relative to the pre-ban levels. In the baseline, it is also assumed that 50 percent of PWC users who engaged in PWC use in CHIC prior to the ban continue to visit CHIC for other recreational activities.

### **Alternative A**

This alternative reinstates PWC use in CHIC as previously managed prior to the ban. NPS assumes that PWC-related shops in the region will regain 100 percent of pre-ban PWC revenues related to CHIC. In addition, NPS assumes that the environmental impacts of PWC use under this alternative will be equal to those observed before the ban was implemented.

### **Alternative B**

The preferred alternative reinstates PWC use in CHIC with additional management restrictions, such as an expansion of no-wake zones, and increased user fees. NPS assumes that the costs and benefits associated with this alternative will be similar to Alternative A, but costs to non-PWC users may be mitigated somewhat due to lower total numbers of PWC on the lake and more responsible use of PWC, especially in environmentally sensitive areas. Likewise, benefits to PWC users and businesses may be reduced somewhat due to the increased restrictions on using PWC at CHIC.

### **Alternative C**

The third alternative reinstates PWC use in CHIC with the restrictions identified in Alternative B, plus additional restrictions such as confinement of PWC use to the main body of the lake, mandatory programs for PWC users and expansion of no-wake zones. NPS assumes that PWC visitation and, as a result, PWC-related revenues, would be slightly lower under this alternative than under Alternative B. Conversely, it is expected that more non-PWC users would visit the park than under the previous set of management practices, as the negative externalities associated with PWC use would be reduced.

### **Alternative D (No-Action)**

This alternative would maintain the November 2002 ban of PWC from CHIC. Under this alternative, NPS assumes there will be no incremental impacts on revenues for businesses providing services to PWC users or on the welfare of park visitors.

#### **4.2.3 Costs**

As described in Section 2.5, Section 4.1, and Appendix B, PWC use in national parks can be linked to a wide variety of negative

impacts. Allowing their use in these parks can therefore harm society in a number of ways. Section 2.5 specifically describes the impacts on natural resources that may result from PWC use within the boundaries of CHIC. This section describes how the regulatory alternatives identified above will affect these impacts and assesses the costs of these regulations. Assessing these costs in strictly quantitative (i.e., monetary) terms is not feasible with currently available data.

Those bearing the largest share of the costs as a result of implementing Alternative A, B, or C would be CHIC visitors who do not use PWC and whose park experience is negatively affected by the presence of PWC in the park. Alternative D is not expected to result in any incremental costs to park users because it continues baseline use patterns. In CHIC, popular activities other than PWC use include boating, angling, swimming, hiking, and picnicking. As shown in Table 2-2, in 2001 the number of recreational visits to the park was roughly 1.6 million. Non-PWC users accounted for over 98 percent of total visitation (NPS, 2002a).

“Nonusers” of the park are also likely to bear costs as a result of PWC regulations in CHIC (see Section 4.1 and Appendix B for more details). For example, individuals who do not visit the parks can experience a decline in welfare simply from the knowledge that the natural resources of the park may be degraded by PWC use. Part of this loss may stem from a decreased assurance that the quality of the park’s resources is being protected for the enjoyment of future generations. Therefore, some of the cost categories described below, in particular those associated with the degradation of unique park resources and ecosystems, may accrue in the form of nonuse values.<sup>1</sup>

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<sup>1</sup>The importance of recognizing these values is affirmed in the Organic Act. It established the fundamental purpose of the national park system, which includes providing for the enjoyment of park resources and values by the people of the United States. The mandate applies not just to the people who visit parks—but to all people—including those who derive inspiration and knowledge from afar. Furthermore, through the Redwood Act of March 27, 1978, Congress has provided that when there is a conflict between conserving national park resources and values and providing for enjoyment of them, conservation is to be the primary concern.

### **Aesthetic Costs—Noise and Visibility Impacts**

Alternatives that reinstate PWC use will increase noise levels in CHIC and reduce the level of natural quiet along portions of the shoreline. They also have the potential to degrade visibility by leading to an increase in the amount of ozone-causing emissions. However, because a large number of motorized boats already operate at CHIC in the baseline, the incremental negative impacts of allowing PWC in the park are likely to be relatively small.

**Alternative A:** This alternative will have the greatest impact because it will allow PWC in all pre-ban areas of CHIC. However, noise from other boating activities is prevalent in the baseline. Thus, the incremental impact due to PWC use in the park is expected to be minor to moderate. It is expected that, with improved technology, quieter PWC will become the standard, and sounds generated by PWC will decrease over time.

**Alternative B:** This alternative will have much the same impact as Alternative A, because it does not significantly increase the portion of CHIC where PWC activity is restricted and higher user fees are not expected to deter large numbers of PWC users.

**Alternative C:** This alternative will have much the same impact as Alternative B, although localized impacts from noise in the arms of the lake will be reduced.

**Alternative D (No-Action Alternative):** This alternative continues baseline management and offers no change in soundscape or visibility relative to baseline conditions.

Reinstating PWC use under Alternative A, B, or C will impose costs to recreators in the park, such as canoeists, anglers, birdwatchers, and hikers, relative to baseline conditions. Noise emissions have been identified as a particular nuisance to nonmotorized recreators, such as canoeists and hikers, who tend to place a particularly high value on the tranquility and natural soundscape offered by the parks. Anglers using motorized boats also value the natural soundscape. Therefore, increasing noise from PWC activity in the parks will degrade the experience for both motorized and nonmotorized recreators.

In addition to generating high noise levels, PWC also emit strong-smelling fumes that can be bothersome to other recreators and

reduce visibility. These effects tend to be much more localized than noise emissions. Finally, NPS assumes that visibility impacts from emission increases resulting from allowing PWC under these alternatives will be negligible.

### **Human Health Costs**

PWC emissions contain relatively high levels of pollutants such as VOC, CO, PM, NO<sub>x</sub>, and HCs, which are potentially damaging to human health. It is very unlikely that historic PWC use in CHIC represented a significant health threat to humans; nevertheless, the potential for adverse health effects exists. For example, some of the toxic HCs are potentially harmful even at very low levels of exposure (EPA, 2000a; EPA, 1999a). The continued use of other motorized watercraft in CHIC means that, even if PWC remain banned, the types of emissions that cause PWC to be harmful to human health would be present in the air and water at CHIC. In summary, the human health costs related to both air and water quality impacts of the regulations are expected to be minor to moderate for the alternatives that would reinstate PWC use. No impact on human health is expected under Alternative D.

### **Ecosystem Degradation Costs**

As discussed in Sections 2 and 4.1 of this report, PWC use has the potential to negatively affect ecosystems and natural habitats in a variety of ways. In the case of national parks, these natural resources are of particular value to the public. Although PWC use in CHIC is not expected to cause widespread ecosystem damages, allowing PWC in the park can nonetheless cause damage to the welfare of visitors and nonusers by degrading some of the park's natural resources.

**Alternative A:** The EA for PWC use at CHIC states that long-term impacts on wildlife and wildlife habitat were negligible to minor prior to the ban. Therefore, allowing PWC in the park as previously managed without additional geographic or no-wake restrictions is expected to have negligible to minor ecosystem impacts.

**Alternative B:** Like Alternative A, this alternative would have negligible to minor impacts on park ecosystems. Any impact on these resources would likely be smaller than under Alternative A as the total number of PWC users would be reduced.

**Alternative C:** This alternative would have a negligible to minor impact on park ecosystems. These effects are likely to be very similar to those under Alternative B, except that localized impacts in the arms of the lake would no longer be an issue.

**Alternative D (No-Action Alternative):** This alternative would have no impact on water quality and natural resources relative to baseline conditions.

As discussed in Section 2.5 of this report, PWC use has the potential to negatively affect fish and wildlife in a variety of ways. In addition to being a potential nuisance to other recreators, noise from PWC may disturb wildlife. Localized, short-term effects on wildlife could occur under Alternative A, B, or C, by increasing noise disturbance and the chance for collisions with wildlife. However, the long-term impact to aquatic biota and the ecosystems in the park is expected to be negligible because no ecotoxicological benchmark exceedances are anticipated.

Although the impacts of reinstating PWC are expected to be limited, any harm to the park's ecosystems could degrade the experience of park visitors, for example, by decreasing their chances of viewing wildlife in a natural environment. It could also result in welfare losses to individuals across the country that value the park's unique ecosystems and natural habitats, regardless of whether they actually visit the park. That is, any degradation of the park's ecosystems can result in nonuse costs to society.

### **Safety and Congestion Costs**

In addition to environmental costs associated with increases in PWC use, there also may be safety and congestion costs. Since 1990, injuries associated with the recreational use of PWC have increased at least four-fold. The number of injuries reported from PWC use is now higher than that reported from motorboat use in the United States (Branche, Conn, and Annett, 1997). Because of the disproportionately large number of injuries associated with PWC use, allowing their use may decrease the safety of park visitors. In addition, the level of congestion is an important factor determining visitor enjoyment. Increases in congestion related to PWC use may therefore have costs to other park users.

**Alternative A:** This alternative has the potential to increase PWC-related accidents in CHIC relative to baseline conditions (where there are none because PWC are banned). Overall safety and congestion impacts at CHIC are expected to be minor to moderate. However, because congestion might decrease in substitute areas, it is possible that accidents involving PWC could decrease overall because PWC use is distributed over a larger area when CHIC becomes available for use.

**Alternative B:** Like Alternative A, this alternative has the potential to bring about a minor to moderate increase in safety risks and congestion in CHIC, but because PWC use may decrease in non-NPS waters as PWC users switch back to CHIC, the overall effect on safety and congestion is unknown.

**Alternative C:** The risk of safety and congestion costs resulting from this alternative is expected to be similar to Alternative B. The increased concentration of PWC in the main body of the lake brought about by closing the arms to PWC use should be offset by additional safety requirements.

**Alternative D (No-Action Alternative):** This alternative would have no effect on safety and congestion in CHIC relative to baseline conditions.

Any increase in PWC-related accidents will also increase the costs to NPS associated with medical/rescue operations, relative to baseline conditions. The additional burden on CHIC staff is expected to be minor to moderate.

#### 4.2.4 Benefits

PWC users, as well as some businesses in the local area, may experience welfare gains as a result of the proposed alternative regulations.

##### **Benefits to PWC Users**

For PWC users who currently ride in CHIC or who want to ride in the park in the future, reinstating PWC use in the park could result in consumer surplus gains.

Two main groups of PWC users may be affected by the regulations: those who used PWC in CHIC and those who use PWC in substitute areas outside CHIC, where PWC users displaced from CHIC ride due to the ban in CHIC.

PWC users who currently ride in nearby areas, where displaced riders from CHIC may have visited, will gain some consumer

surplus if these areas are less crowded than under baseline conditions because of reinstating PWC use in CHIC. Although no studies were available that examined the impact of congestion on the value of a PWC trip, other recreation demand studies find that congestion lowers the value of a recreation experience (see Appendix B). For PWC users who rode in CHIC or who want to ride in the park in the future, allowing PWC use in the park could result in consumer surplus gains. To the extent that individuals consider other PWC areas, such as those in the nearby area, close substitutes, the change in consumer surplus associated with allowing PWC use in the park will be lower. In the case of CHIC, there are few nearby substitute areas where PWC are permitted (see Section 2.3).

If each individual's demand curve for riding a PWC in CHIC were known, then NPS could add up the gains of consumer surplus for each individual to find the total change in consumer surplus to PWC riders from the proposed management alternatives. Because the demand curve reflects the individual's preferences for available substitute activities and the cost of these activities, measuring the change in consumer surplus from a trip in the park takes into account substitute activities. In this case, NPS does not know the consumer surplus associated with PWC use in CHIC, nor does NPS know the riders' next best alternative activities.

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*To assess the incremental change in consumer surplus for PWC users, NPS used the benefit transfer technique.*

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To assess the incremental change in consumer surplus for PWC users, NPS used the benefit transfer technique. After conducting an extensive review of the economics literature and consulting with the authors of existing studies, experts in recreation demand analysis at universities, and experts at consulting firms, NPS was unable to locate a study that estimated the consumer surplus for a PWC trip. A review of the recreation literature conducted by Rosenberger and Loomis (2000) found an average value of \$31.98 (1996 dollars) per person, per day for riding in motor boats in the entire United States (with estimates ranging from \$15 to over \$50). Bhat et al. (1998) estimate an average consumer surplus of \$28.56 (1998 dollars) associated with motor boating and waterskiing in an area that includes western Texas and New Mexico, states bordering Oklahoma. In the absence of an estimate for the region in which Oklahoma is included, the aforementioned consumer surplus figure is useful as the best available approximation. Converted to 2001



dollars, the average consumer surplus reported in this study is \$31.03. The estimate comes from a travel cost model based on data from the Public Area Recreation Visitors Study (PARVS). The PARVS data was a multiagency survey that included on-site interviews of recreationists at over 350 sites across the United States between 1985 and 1992. For the benefit transfer, NPS used the value from Bhat et al. (1998) based on the following criteria:

- Waterskiing and motor boating are similar activities to PWC use.
- The region where the data was collected includes parts of Texas and New Mexico, which border Oklahoma.
- Bhat et al. (1998) was published in a peer-reviewed journal. The authors estimate a travel cost model using data from on-site interviews and only estimate values for activities in a particular region for which at least 100 observations were collected.

Below, NPS discusses the estimated impact of each proposed alternative on PWC users.

**Alternative A:** This alternative would reinstate PWC use in CHIC as previously managed. All visitors using PWC in CHIC prior to the ban are assumed to regain the full value of their consumer surplus for PWC use in CHIC.

**Alternative B:** This alternative, much like Alternative A, would allow PWC use in CHIC but would increase user fees and implement additional management restrictions such as no-wake zones. These restrictions may cause PWC users to regain only a portion of their consumer surplus. However, given the lack of suitable substitute areas for PWC use nearby, these additional stipulations are not expected to have a sizeable affect on the behavior of PWC users at CHIC. NPS expects the differences between consumer surplus gains under this alternative and Alternative A to be minor.

**Alternative C:** This alternative would uphold the management practices prescribed for Alternative B. In addition, it would prohibit PWC from operating in the arms of Lake of the Arbuckles and establish mandatory safety programs and additional restricted areas. This may reduce the value associated with riding a PWC in the park and cause PWC users to regain only a portion of their consumer

surplus. NPS expects the consumer surplus gains under this alternative to be somewhat lower than under Alternative B.

**Alternative D (No-Action Alternative):** The no-action alternative would maintain the current ban on PWC use in CHIC. This would not change regulations relative to baseline conditions and, consequently, would not have any incremental impact on the consumer surplus of any user group.

Using the value of \$31.03 for a day of PWC use, NPS provides estimates of possible incremental gains in consumer surplus to PWC users as a result of Alternatives A, B and C. For Alternative D, NPS assumes there would be no change in visitation to CHIC by PWC users and no measurable change in consumer surplus. Table 4-4 summarizes the projected consumer surplus gains for PWC users in CHIC for Alternatives A, B, and C and the no-action alternative from 2003 to 2012 and the present value (PV) of these gains using both 3 percent and 7 percent discount rates. PV is the value of a future stream of benefits or costs, discounted to current years. Depending on the discount rate and scenario, the present value of consumer surplus gains for PWC users in CHIC from Alternatives A, B, and C from 2003 to 2012 ranges from approximately \$5,399,420 to \$8,222,440.

**Uncertainty:** The estimates of consumer surplus gains to PWC users are uncertain for a variety of reasons. Some of the main sources of uncertainty are as follows:

- The estimates of the number of PWC users expected to visit CHIC under each of the alternatives are uncertain, as are the projections of future PWC use.
- The actual consumer surplus associated with PWC use in CHIC may be different from the value used in the analysis. The value used in the analysis is based on studies of riding in motor boats and waterskiing in the Desert Southwest ecoregion, which does not include Oklahoma. In addition, the value is based on a full day of motorized water-based recreation. Many local PWC users at CHIC may use PWC for only a small fraction of the day, such as in the evening on weekdays. To the extent that these visitors represent a large share of total PWC users at CHIC, consumer surplus for PWC users may be closer to non-PWC users' surplus value (estimated in 4.2.3) than to other motorized watercraft users' surplus.

**Table 4-4. Projected Incremental Change in Consumer Surplus for PWC Users under Alternatives A, B, and C, 2003-2012 (2001\$)<sup>a</sup>**

Year	Alternative A		Alternative B		Alternative B	
	Change in Number of People Using PWC	Change in Consumer Surplus (\$)	Change in Number of People Using PWC	Change in Consumer Surplus (\$)	Change in Number of People Using PWC	Change in Consumer Surplus (\$)
2003	29,765	\$923,570	26,789	\$ 831,220	23,812	\$738,860
2004	30,063	\$932,810	27,057	\$ 839,530	24,050	\$746,250
2005	30,364	\$942,140	27,327	\$ 847,920	24,291	\$753,710
2006	30,667	\$951,560	27,600	\$ 856,400	24,534	\$761,250
2007	30,974	\$961,070	27,877	\$ 864,970	24,779	\$768,860
2008	31,284	\$970,680	28,155	\$ 873,620	25,027	\$776,550
2009	31,596	\$980,390	28,437	\$ 882,350	25,277	\$784,310
2010	31,912	\$990,190	28,721	\$ 891,180	25,530	\$792,160
2011	32,232	\$1,000,100	29,008	\$ 900,090	25,785	\$800,080
2012	32,554	\$1,010,100	29,298	\$ 909,090	26,043	\$808,080
NPV (3%) <sup>b</sup>	NA	\$8,222,440	NA	\$7,400,220	NA	\$6,577,970
NPV (7%) <sup>c</sup>	NA	\$6,749,250	NA	\$6,074,340	NA	\$5,399,420

<sup>a</sup>All impacts were rounded to the nearest \$10. Columns may not sum to totals due to rounding.

<sup>b</sup>The economics literature supports a 3 percent discount rate in the valuation of public goods (e.g., Freeman, 1993). Federal rule-makings also support a 3 percent discount rate in the valuation of lost natural resources use (61 FR 453; 61 FR 20584).

<sup>c</sup>Office of Management and Budget (OMB). 2002. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs: Memorandum for Heads of Executive Departments and Establishments." OMB Circular A-94, revised January 22, 2002.

- The values in Table 4-4 may overestimate true gains under Alternatives B and C because of assumptions about the consumer surplus of PWC users who ride in the park. In the analysis of Alternatives B and C, PWC users who continue to use PWC in CHIC may be inconvenienced by the increased user fees, closure of the lake arms and other areas, safety programs and no-wake zones. These requirements may decrease the consumer surplus associated with using a PWC in CHIC, even for those who decide to resume visiting the park for this purpose.
- The 1996 EPA Marine Engine Rule may result in lower PWC use if the cost of new machines increases. If fewer riders would visit the park, the incremental consumer surplus gains associated with Alternative A, B, or C would be lower.

### **Benefits to the Local Area Businesses**

If PWC use increases as a result of the regulation, then the suppliers of PWC accessories and storage will be directly affected. In addition, lodging establishments, restaurants, gas stations, and other

businesses that serve PWC riders could experience an increase in business from the regulation. The following section describes the approach used to develop quantitative estimates of these impacts and reports the results of the cost analysis for local area businesses.

**PWC Accessories and Storage Services.** NPS identified one firm that sells PWC accessories and two firms that store PWC in the CHIC area. It is assumed that all three firms would be affected by changes to PWC regulations in CHIC. However, none of the potentially affected shops relies exclusively on PWC revenue. Additional sources of revenue for these shops involve sales of other types of boating equipment and general storage.

**Lodging Establishments, Restaurants, Gas Stations, and Other Businesses.** Purchases made by PWC users contribute to total economic activity in the area surrounding CHIC. It is possible that localized impacts on tourism-related businesses located near CHIC will occur if PWC regulations result in increased visitation to the recreation area. However, historically PWC users comprised a small fraction of total visitation to the CHIC area. Therefore, lodging establishments, restaurants, gas stations, and other businesses that serve PWC riders are not likely to experience a substantial increase in business under any of the proposed alternatives reinstating PWC use.

NPS does not expect Alternative D to result in revenue gains to firms relative to the baseline because visitation is not expected to change relative to the baseline under this alternative. Based on the existing data and interviews with local businesses, NPS calculated revenue gains under Alternatives A, B, and C for the following business categories: PWC-related sales (e.g., accessories), PWC storage, lodging, restaurants, supermarkets, gasoline, local transportation, admissions/fees and souvenir/retail shops. These revenue gains are presented in Table 3-4.

PWC storage facilities are projected to gain \$36,210 under Alternative A, \$32,590 under Alternative B and \$28,970 under Alternative C. PWC equipment shops are expected to gain \$262,170 under Alternative A, \$235,950 under Alternative B and \$209,730 under Alternative C. These two categories represent more than 50 percent of the total expected gains for businesses. Lodging establishments are expected to gain \$18,520 to \$57,880 from

reinstating PWC use at CHIC, depending on the alternative selected. Restaurants and bars are projected to gain \$24,540 to \$76,670 in revenues. The remaining business categories (supermarkets, gasoline and oil, local transportation admissions/fees, etc.) are expected to gain a total of \$80,590 to \$161,300, depending upon the alternative selected.

To translate increased PWC revenue into producer surplus gains for purposes of benefit-cost analysis, NPS used estimates of the increase in revenue associated with the rule and the return-on-sales measure for the Standard Industrial Classification (SIC) code provided by Dun & Bradstreet (D&B). The use of this profit margin only approximates gains in producer surplus. Producer surplus captures the difference between marginal costs and marginal revenue, while return on sales contains other measures reflecting fixed costs, taxes, and/or accounting conventions rather than measures of variable profits. For this reason, the use of D&B accounting profit margin data may understate producer surplus gains.

The profit ratios presented in Table 4-5, net profit after tax divided by sales, come from D&B (2001).<sup>2</sup> The upper quartile profit ratio for sales shops is 4.6 percent and the lowest quartile is 0.6 percent. The upper quartile profit ratio for storage is 8.7 percent and the lowest quartile is -3.4 percent. However, neither of the storage facilities that NPS interviewed indicated that they had a negative profit margin. Therefore, NPS used the median profit ratio (3.9 percent) as the low value in this analysis.

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<sup>2</sup>Dun & Bradstreet data for NAICS codes are not currently available. Therefore, NPS used the comparable SIC code 5571 (Motorcycle Dealers) as defined by the U.S. Census (i.e., SIC 5571, Motorcycle Dealers) for PWC dealerships. For rental shops, NPS used SIC code 7999 (Amusement and Recreation NEC).

**Table 4-5. Profit Ratios Used for Calculating Producer Surplus Losses**

	Profit Ratios		
	SIC	Bottom Quartile	Upper Quartile
PWC sales	5571	0.60%	4.60%
PWC storage	7999	3.90%	8.70%
Lodging	7011	1.30%	14.70%
Restaurants and bars	5812	0.60%	7.50%
Grocery stores	5411	0.40%	3.00%
Gas and oil	5541	0.10%	3.10%
Souvenir shops and other retail establishments	5947	1.10%	9.90%

For businesses in the CHIC region, estimated producer surplus gains associated with imposing the regulatory alternatives relative to a 2002 baseline are presented in Table 4-6.<sup>3</sup> Total expected producer surplus gains range from \$5,420 to \$41,400 under Alternative A, \$4,650 to \$34,640 under Alternative B, and \$3,490 to \$23,420 under Alternative C. The largest increase in producer surplus occurs in the PWC equipment retail markets category, with increases ranging from \$1,260 to \$12,060 across these alternatives. Producer surplus gains for other impacted categories range from \$10 to \$8,570, depending upon the business category, the alternative and the profit ratio used. Under Alternative D, there are no projected gains in producer surplus because there is no change relative to the baseline.

Table 4-7 summarizes the estimated change in producer surplus for the period from 2003-2012. The present value of incremental gains in producer surplus for Alternative A is between \$48,270 and \$368,570 with a 3 percent discount rate and \$39,620 to \$302,540 when a 7 percent discount rate is used. For Alternative B, the present value of producer surplus gain is estimated to be \$41,480 to \$308,410 using a 3 percent discount rate and \$34,050 to \$253,150 using a 7 percent discount rate. The corresponding predictions for Alternative C are \$31,150 to \$208,490 using a 3 percent discount rate and \$25,560 to \$171,140 using a 7 percent discount rate. There is no change in producer surplus under Alternative D, the no-action alternative.

<sup>3</sup>Estimated producer surplus losses in future years have a similar distribution across industries.

**Table 4-6. Changes in 2003 Producer Surplus Resulting from Reinstating PWC Use in CHIC (2001\$)<sup>a</sup>**

	Alternative A		Alternative B		Alternative C	
	Low	High	Low	High	Low	High
PWC storage	\$1,410	\$3,150	\$1,270	\$2,840	\$1,130	\$2,520
PWC accessories	\$1,570	\$12,060	\$1,420	\$10,850	\$1,260	\$9,650
Lodging	\$870	\$9,870	\$700	\$7,900	\$280	\$3,160
Restaurants and bars	\$460	\$5,750	\$370	\$4,600	\$150	\$1,840
Groceries/take-out	\$130	\$970	\$100	\$770	\$40	\$310
Gas and oil	\$30	\$1,030	\$30	\$830	\$10	\$330
Souvenirs and other retail	\$950	\$8,570	\$760	\$6,850	\$620	\$5,610
<b>Total</b>	<b>\$5,420</b>	<b>\$41,400</b>	<b>\$4,650</b>	<b>\$34,640</b>	<b>\$3,490</b>	<b>\$23,420</b>

<sup>a</sup>All impacts were rounded to the nearest \$10. Columns may not sum to totals due to rounding.

**Table 4-7. Changes in Producer Surplus Resulting from Reinstating PWC Use in CHIC, 2003-2012 (2001\$)<sup>a</sup>**

Year	Alternative A		Alternative B		Alternative C	
	Low	High	Low	High	Low	High
2003	\$5,420	\$41,400	\$4,650	\$34,640	\$3,490	\$23,420
2004	\$5,470	\$41,810	\$4,700	\$34,990	\$3,520	\$23,650
2005	\$5,520	\$42,230	\$4,750	\$35,340	\$3,560	\$23,890
2006	\$5,580	\$42,650	\$4,800	\$35,690	\$3,600	\$24,130
2007	\$5,640	\$43,080	\$4,850	\$36,050	\$3,640	\$24,370
2008	\$5,700	\$43,510	\$4,900	\$36,410	\$3,680	\$24,610
2009	\$5,760	\$43,950	\$4,950	\$36,770	\$3,720	\$24,860
2010	\$5,820	\$44,390	\$5,000	\$37,140	\$3,760	\$25,110
2011	\$5,880	\$44,830	\$5,050	\$37,510	\$3,800	\$25,360
2012	\$5,940	\$45,280	\$5,100	\$37,890	\$3,840	\$25,610
PV (3%) <sup>b</sup>	<b>\$48,270</b>	<b>\$368,570</b>	<b>\$41,480</b>	<b>\$308,410</b>	<b>\$31,150</b>	<b>\$208,490</b>
PV (7%) <sup>c</sup>	<b>\$39,620</b>	<b>\$302,540</b>	<b>\$34,050</b>	<b>\$253,150</b>	<b>\$25,560</b>	<b>\$171,140</b>

<sup>a</sup>All impacts were rounded to the nearest \$10. Columns may not sum to totals due to rounding.

<sup>b</sup>The economics literature supports a 3 percent discount rate in the valuation of public goods (e.g., Freeman, 1993). Federal rule-makings also support a 3 percent discount rate in the valuation of lost natural resources use (61 FR 453; 61 FR 20584). While the welfare impacts in this case are for private goods, the 3 percent discount rate was used to be consistent with discounting of other impacts in this report.

<sup>c</sup>Office of Management and Budget (OMB). 2002. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs: Memorandum for Heads of Executive Departments and Establishments." OMB Circular A-94, revised January 22, 2002.

### **Uncertainty**

A number of factors will affect local business revenue and producer surplus gains associated with the proposed alternatives. Important factors include the uncertainty surrounding the baseline visitation projections as described in Section 2.2, uncertainty concerning the estimation of output increases as described in Section 3.3.8, and the use of national average accounting profit ratios to approximate producer surplus gains to individual local businesses.

#### *NPS Enforcement Costs*

As a result of lifting the ban on PWC use in CHIC, costs are expected to be incurred by taxpayers to support an increase in enforcement efforts by park staff. Although NPS expects that additional staff may be required under Alternatives A, B, and C relative to the baseline, the number of staff (if any) that would be hired is uncertain.

Consequently, NPS does not quantify enforcement costs associated with the implementation of Alternatives A, B, and C. Alternative D, which continues baseline conditions, will not result in any additional enforcement costs for CHIC.

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## **4.3 SUMMARY**

Alternative D, the no-action alternative, entails the continuation of baseline conditions. Under that alternative, all PWC use would remain prohibited from the park. Alternatives B and C would permit PWC use with certain restrictions, and Alternative A would permit PWC use as previously managed in the park (pre-ban). The benefits of any alternative are measured relative to the baseline conditions, which are represented by Alternative D. Therefore, there are no incremental benefits associated with Alternative D. The primary beneficiaries of Alternative A, B, or C would be the park visitors who use PWC and the businesses that provide services to PWC users such as rental shops, restaurants, gas stations, and hotels. Additional beneficiaries include individuals who use PWC outside the park where PWC users displaced from the park may decide to ride if PWC use within the park were prohibited.

Benefits accruing to individual PWC users are called consumer surplus gains, and those accruing to businesses are called producer surplus gains. Consumer surplus measures the net economic benefit



obtained by individuals from participating in their chosen activities, while producer surplus measures the net economic benefit obtained by businesses from providing services to individuals. Over the period from 2003 to 2012, the present value of consumer surplus for PWC users is expected to increase by \$5,399,420 to \$8,222,440, and producer surplus is expected to increase by \$25,560 to \$368,570 if PWC use in the park is reinstated, depending upon the assumptions used. These benefits, projected over a 10-year horizon, are summarized in Table 4-8.

**Table 4-8. Present Value of Projected Incremental Benefits Under Alternatives A, B, and C, 2003–2012 (2001\$)<sup>a</sup>**

	PWC Users	Businesses	Total
<b>Alternative A</b>			
Discounted at 3% <sup>b</sup>	\$8,222,440	\$48,270–\$368,570	\$8,270,710–\$8,591,010
Discounted at 7% <sup>c</sup>	\$6,749,250	\$39,620–\$302,540	\$6,788,870–\$7,051,790
<b>Alternative B</b>			
Discounted at 3% <sup>b</sup>	\$7,400,220	\$41,480–\$308,410	\$7,441,700–\$7,708,630
Discounted at 7% <sup>c</sup>	\$6,074,340	\$34,050–\$253,150	\$6,108,390–\$6,327,490
<b>Alternative C</b>			
Discounted at 3% <sup>b</sup>	\$6,577,970	\$31,150–\$208,490	\$6,609,120–\$6,786,460
Discounted at 7% <sup>c</sup>	\$5,399,420	\$25,560–\$171,140	\$5,424,980–\$5,570,560

<sup>a</sup>All impacts were rounded to the nearest \$10. Columns may not sum to totals due to rounding.

<sup>b</sup>The economics literature supports a 3 percent discount rate in the valuation of public goods (e.g., Freeman, 1993). Federal rule-makings also support a 3 percent discount rate in the valuation of lost natural resources use (61 FR 453; 61 FR 20584). While the welfare impacts in this case are for private goods, the 3 percent discount rate was used to be consistent with discounting of other impacts in this report.

<sup>c</sup>Office of Management and Budget (OMB). 2002. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs: Memorandum for Heads of Executive Departments and Establishments." OMB Circular A-94, revised January 22, 2002.

As with the benefits described above, the costs of any alternative are measured relative to the baseline conditions, which are represented by Alternative D. Therefore, there are no incremental costs associated with Alternative D. The primary group that would incur costs under Alternative A, B, or C is the park visitors who do not use PWC and whose park experiences would be negatively affected by PWC use within the park. At CHIC, non-PWC uses include boating, canoeing, fishing, and hiking. Additionally, the public could incur costs associated with impacts from Alternative A, B, or C to aesthetics, ecosystem protection, human health and safety,

congestion, nonuse values, and enforcement. However, these costs could not be quantified because of a lack of available data.

Because the costs of the alternatives are not quantified, the benefits presented in Table 4-8 represent the quantified net benefits of Alternatives A, B, and C. As noted above, these net benefits do not account for the costs of enforcement; the costs to non-PWC users; or those costs relating to aesthetics, ecosystem protection, human health and safety, congestion, or nonuse values as a result of a lack of available data. Therefore, these net benefit estimates do not reflect all costs. If all costs could be incorporated, the indicated net benefits for each alternative would be lower.

From an economic perspective, the selection of Alternative B as the preferred alternative was considered reasonable even though the quantified benefits are smaller than under Alternative A because certain costs could not be quantified in the net benefits presented above. Those costs, relating to non-PWC use, aesthetics, ecosystem protection, human health and safety, congestion, or nonuse values, would likely be greater for Alternative A than for Alternative B. Inclusion of these costs could reasonably result in Alternative B having the greatest level of net benefits.

# 5

## Small Entity Impact Analysis

Alternatives A, B, and C are expected to have positive effects on small businesses relative to baseline conditions, while Alternative D has no incremental impacts.

Changes to the management of PWC use in national parks potentially affect the economic welfare of a number of businesses, large and small. However, small entities may have special problems in complying with such regulations. The Regulatory Flexibility Act (RFA) of 1980, as amended in 1996, requires special consideration be given to these entities during the regulatory process.

To fulfill these requirements, agencies must perform a review to determine whether a proposed or final rule will have a significant economic impact on a substantial number of small entities. This section assesses the potential for PWC regulations in CHIC to affect small businesses. Expected changes in revenues across firms and regional economic impacts are discussed in Section 3, and expected changes in producer surplus are discussed in Section 4.

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### 5.1 IDENTIFYING SMALL ENTITIES

As described in Sections 2 and 3, NPS attempted to identify the firms in the region surrounding CHIC that would experience the most significant impacts as a result of PWC regulations in CHIC. Small entities potentially affected by the regulations include companies providing PWC rentals, sales, and service; lodging establishments; restaurants; grocery stores; and other retail businesses. The minimal expected changes in visitation to the area as a result of implementing Alternative A, B, or C suggest that there will be no noticeable regional impacts on restaurants, grocery stores, or other retail businesses. It is possible that these tourism-

related industries may experience localized impacts in communities located adjacent to CHIC, but any impacts are expected to be small relative to the impacts estimated for businesses that provide PWC sales, rentals, and service. The impacts on the PWC-related businesses considered are believed to be representative of the upper bound of impacts that would be experienced by local businesses under Alternative A, B, or C. Under Alternative D, the no-action alternative, no incremental impacts are expected for small businesses because it maintains baseline management conditions under which PWC were banned from CHIC in November 2002.

NPS considered all of the three directly affected firms as small for this analysis.

NPS identified one sporting goods store that sells PWC accessories and two firms that offer PWC storage located in communities near CHIC. The SBA's general size standard definitions for PWC-related industries (NAICS 532292—Recreational Goods Rental<sup>1</sup> and NAICS 441221—Motorcycle Dealers<sup>2</sup>) classify companies with annual sales less than or equal to \$5 million as small. Based on interviews and data reported by *infoUSA* (2002), two of the three potentially affected companies have less than \$500,000 in annual sales and the third has annual sales of approximately \$2 million. Using this criterion and sales data, all three firms are classified as small businesses. NPS estimated that these three firms had a total of \$2.21 million in annual revenue in 2000.

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## 5.2 ASSESSMENT

Do the proposed regulations have a significant negative impact on a substantial number of small entities?

Alternative A: No

Alternative B: No

Alternative C: No

Alternative D: No

After considering the economic impacts of the PWC regulations in CHIC on small entities, NPS concludes that none of the management alternatives will have a significant negative impact on a substantial number of small businesses. Alternatives A, B, and C will have a positive impact on small businesses relative to the baseline scenario, under which PWC were banned from CHIC in November 2002. The no-action alternative (Alternative D) will not have an impact on small entities because it will not result in a change from baseline conditions. NPS made the determination that

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<sup>1</sup>This industry comprises establishments primarily engaged in renting recreational goods, such as bicycles, canoes, motorcycles, skis, sailboats, beach chairs, and beach umbrellas.

<sup>2</sup>This industry comprises establishments primarily engaged in retailing new and/or used motorcycles, motor scooters, motor bikes, mopeds, off-road all-terrain vehicles, and PWC or retailing these new vehicles in combination with repair services and selling replacement parts and accessories.

these management alternatives would not have a significant impact on small entities using RFA implementation guidance provided by other agencies (NMFS, 2000; EPA, 1999b; SBA, 2003) and provides the following factual basis for this determination:

- This rule is not expected to reduce any of the area businesses' profit margins or reduce the competitiveness of the PWC rental and retail businesses.
- None of the proposed alternatives is expected to cause any small businesses in the CHIC area to close.
- NPS projects small increases in revenue relative to the baseline for firms storing PWC and selling PWC accessories to CHIC visitors under Alternatives A, B, and C.
- NPS projects slightly higher overall levels of revenue for other businesses (including hotels, restaurants, grocery stores, gas stations, and souvenir shops) in the CHIC region relative to the baseline under Alternatives A, B, and C.
- NPS projects no change in revenue for local small businesses relative to baseline conditions under Alternative D, the no-action alternative.

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# **Appendix A: Economic Impact Analysis**

Expenditures made by visitors to national parks have a variety of economic impacts on the region where the park is located. For instance, tourists contribute to sales, profits, jobs, tax revenues, and income in a region. The most direct effects are felt within the primary tourism sectors: lodging, dining, transportation, entertainment, and retail trade. However, when indirect effects are included, almost all sectors of the economy are affected by tourism. This occurs because spending by tourists on the primary tourist sectors leads those sectors to purchase inputs into their production process from other industries, which then purchase more inputs themselves and so on. In addition, as local household income rises because of the impact of tourism, these households purchase more goods and services from many different industries. This leads to higher incomes for households deriving income from these other industries, which causes them to purchase more goods and services as well. These feedback effects continue indefinitely, but become smaller and smaller in each round as a result of leakage because not all income is spent within the regional economy. These effects on household spending are known as induced effects.

A simple example from Stynes (2000) illustrates this point. Assume a region attracts an additional 100 tourists, each spending \$100 per day. The direct impact of this increase in tourism is \$10,000 per day in new spending. If sustained over a season of 100 days, the region would experience an increase in sales of \$1 million. This spending would primarily take place in the lodging, dining, entertainment, and retail sectors in proportion to how each visitor spends his/her \$100. Not all of the value of this spending can be

assumed to accrue within this region because the cost of goods made in other regions should not be included as a direct sales effect in the local area. For example, gasoline purchased by tourists for \$1.50 per gallon should not be included as a local spending impact of \$1.50 per gallon. Instead, only the retail margin on the gasoline can be considered a direct effect of tourism spending. The margins on gasoline are relatively small. Assuming a retail margin of 12 percent suggests that the direct impact of spending on gasoline to the local area is only about 18 cents per gallon. Wholesale margins are also included for wholesalers located within the region of interest.

Returning to the example above, perhaps 30 percent of the million dollars in direct spending would leak out of the area to cover the costs of goods purchased by tourists that were produced outside the region. The remaining \$700,000 increase in direct sales might yield \$350,000 in income within tourism-related industries and support 20 jobs directly linked to tourism. Tourism industries tend to be labor intensive, translating a relatively high proportion of sales into income and jobs.

The tourism industry buys goods and services from other industries located in the area to provide the goods and services offered to tourists. For example, changes in sales, jobs, and income in the linen industry (an industry supplying products to hotels) will result from changes in hotel sales. Also, as mentioned above, this industry is typically very labor intensive. Therefore, most of the \$350,000 in income will be paid as wages and salaries to tourism industry employees. As a result of this increase in income, these employees will spend more in the local region for an array of household products and services. Assuming a sales multiplier of 2.0 to indicate that each dollar of direct sales generates another dollar of secondary sales implies that the \$700,000 in direct sales within the region leads to a \$1.4 million increase in regional sales as a result of the additional tourists visiting the area. These secondary sales create additional income and employment in the region, with the estimated impact dependent on the multipliers for each particular region. Assume in our case that the total impact of the increase in tourism after applying multipliers is \$1.4 million in sales, \$650,000 in income and 35 jobs.

Although hypothetical, the numbers used in this example are fairly typical of those used in a tourism economic impact study. Through indirect and induced effects, changes in tourist spending can affect almost every sector of the economy to some extent. The magnitude of these effects depends strongly on the extent to which businesses and households in the region purchase goods and services from local suppliers as well as how much household income is affected by the changes in spending. When a large employer closes a plant, the entire local economy may be negatively affected as retail stores close and leakages of spending from the region increase as consumers go outside the region for more of their goods and services. Similar effects in the opposite direction are observed when a new facility opens and there is a significant increase in household income (Stynes, 2000).

In addition to simply estimating the total regional impact, more detailed studies identify the sectors that receive the direct and secondary effects. They may also identify distinct market segments and identify differences in spending and impact between these subgroups. This information is sometimes used to target marketing efforts towards tourists with particular characteristics that are likely to lead to the largest economic impact per marketing dollar. It may also be used simply to better understand the distribution of impacts and to gain a better measure of the expected effects of a change in regional spending. Effects on tax revenues may also be examined by applying local tax rates to changes in sales and income.

The economic impacts resulting from a change in spending are typically measured by

- estimating the change in the number and types of visitors to the region due to the proposed change in policy,
- estimating average levels of spending (often within market segments) of visitors in the local area, and
- providing the estimated change in direct spending as input into a regional economic model to determine secondary effects.

Estimates of changes in visitor activity usually come from a demand model or professional judgment about the changes in visitation likely to take place. This step is often the weakest link in tourism impact studies because most regions do not have accurate counts of

visitors, let alone models for predicting changes in visitation (Stynes, 2000).

Spending averages are usually derived from visitor surveys or may be adapted from other similar studies. Because of differences in visitors, these data are often provided for different segments of the visitor population due to variations in spending patterns based on whether visitors stay overnight, the accommodations they choose, the type of transportation they are using, and other characteristics of their stay.

One of the primary methods used to estimate the secondary economic impacts of a particular action or policy is to apply an input-output (I-O) model. I-O models are mathematical models that describe the relationship between sectors in a region's economy. Regional I-O models are commonly used to estimate the benefits or costs of an event on the economy of a given region. These models are used to estimate linkages among sectors of the economy such that an event directly affecting one sector of the economy can be traced through the impact on the entire regional economy. This approach permits estimation of both the direct impacts in the affected sector as well as indirect impacts that occur as the change in spending by the directly affected industry works its way through the economy. Based on production functions estimating the inputs that each industry must purchase from every other industry to produce their output, these models predict flows of money between sectors. These models also determine the proportion of sales that end up as income and taxes. Multipliers are estimated from I-O models based on the estimated recirculation of spending within the region. The higher the propensity for households and firms within the region to purchase goods and services from local services, the higher the multipliers for the region will be. A number of important assumptions are involved in using I-O models. Some of the basic assumptions include the following:

- **Constant Returns to Scale.** Each industry's production function is assumed to have constant returns to scale. This means that, to produce additional output, all inputs increase proportionately (i.e., if output in an industry were to double, then that industry would double its use of all inputs). Because labor is one of the inputs into production, this implies that jobs will change in exactly the same proportion as output.



- **No Supply Constraints.** Supplies are unlimited. All industries have access to unlimited quantities of raw materials at a constant price with output limited only by demand.
- **Fixed Commodity Input Structure.** This assumption implies that price changes do not cause a firm to purchase substitute goods. This structure assumes that changes in the economy affect the industry's output but not the mix of inputs it uses to make its products.
- **Homogeneous Sector Output.** The proportion of all the commodities produced by an industry will remain the same, regardless of total output. An industry will not increase the output of one product without proportionately increasing the output of all its other products.
- **Industry Technology Assumption.** This assumption is important when data are collected on an industry-by-commodity basis and then converted into industry-by-industry data. It assumes that an industry uses the same technology to produce all of its products. In other words, an industry has a primary product and all other products are by-products of the main product.
- **Identical Firms.** All firms in a given industry employ the same production technology and produce identical products.
- **Model Parameters.** The various model parameters are accurate and represent the current year. These models rely on the national system of accounts to generate model parameters based on standard industrial classification codes and various federal government economic censuses. They are usually at least a few years out-of-date, although this is not usually a major problem unless the region has changed significantly.
- **Induced Effects.** Multiplier computations for induced effects assume that jobs created by additional spending are new jobs involving local households. The induced effects of new spending are calculated assuming linear changes in household spending with changes in income.

These assumptions are necessary to estimate an economic impact model using a typical regional I-O model. However, these assumptions lead to several limitations as noted by Hamilton et al. (1991); Coughlin and Mandelbaum (1991); and Stabler, Van Kooten, and Meyer (1988), among others. Most of these issues apply to alternative models as well and should be considered in interpreting the results of economic impact analyses in general. Some of the biggest limitations associated with this type of analysis are discussed below.

First, all production inputs have an associated opportunity cost. Thus, these opportunity costs should be included in the net benefits calculation, although this is often not considered in an economic impact analysis. Net benefits equal impacts less opportunity costs. In the case of full employment, perfect resource mobility, and absence of scale economies, benefits of a policy, action, or project would be zero because all factors employed as a result could have received the same return without the policy, action, or project in alternative uses. Typically, applications analyzing regional economic analysis assume that there is not full employment and complete mobility in the region being analyzed, but the change in net benefits will still be reduced if opportunity costs are considered.

Another issue is that multipliers estimate short-term changes, ignoring a regional economy's long-term adjustments. Thus, most of the economic effects identified in economic impact analysis are likely to be only transitory as the regional economy adjusts to the change. For example, if jobs are lost in a region because of new regulations, some of this reduction will be temporary because some of the workers whose jobs were eliminated will find new jobs in the region.<sup>1</sup>

Also, if some workers relocate in response to a change in the regional economy, then it is not entirely clear who should be counted in the region when calculating the benefits and costs associated with a change. For example, a new project located in a particular region may attract resources from outside the region. It is not clear that income to these immigrant resources should be counted as regional benefits of the project because people originally from the region do not benefit. However, I-O models typically make no distinction between jobs and sales, for example, going to those people already within the region and benefits going to those people outside the region.

Furthermore, applying multipliers is difficult if industries will move to different points on their cost curves as a result of the change and there are economies or diseconomies of scale. Because I-O models are based on fixed coefficients, they are not able to capture these

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<sup>1</sup>Some workers may not find jobs within the region, even in the long run. The loss of workers who leave for jobs in other regions may tend to slow the region's growth, but such restructuring ultimately improves national economic performance by redistributing resources to their most efficient use.

impacts. These models assume that there are no supply constraints such that industries will not change their relative purchases from other sectors. This requires excess regional production capacity and excess regional labor so that use of these resources can be increased without a change in prices. In many areas, this is unlikely to be the case. Instead, increasing scale may lead to an increase in the price of labor and other resources and may cause a change in the mix of inputs used for production. It may also lead to the use of a different proportion of inputs being purchased from outside the region, which will affect the estimated change in final demand for regional output.

Some additional difficulties with applying regional multipliers include the following:

- multipliers are based on political boundaries (e.g., counties, states) instead of economic areas;
- multipliers may not be constant over time;
- different production functions for different activities are lumped together; and
- information on the relationships between producers in a region is lacking, which makes constructing an accurate set of multipliers very difficult.

Despite these caveats on the use of multipliers, regional I-O models are still considered the best way currently available to cost-effectively estimate the regional impacts of a change that will affect the local economy.

# **Appendix B: Social Benefits and Costs of Personal Watercraft Restrictions**

The purpose of benefit-cost analysis is to evaluate the social welfare implications of a proposed action—in this case the regulation of PWC use in national parks. That is, it assesses whether the action generates benefits to society (gains in social welfare) that are greater than the costs (losses in social welfare). The following sections provide detailed descriptions of the range of social benefits and social costs that may result from PWC restrictions and discuss the ways in which these benefits and costs can be conceptualized and measured.

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## **B.1 SOCIAL BENEFITS OF PWC RESTRICTIONS**

PWC use in national parks may be associated with a number of negative impacts on environmental resources and ecosystems. One result of any negative impacts that occur is that they impose welfare losses on individuals who value the parks' environmental systems. The benefits of PWC restrictions can therefore be thought of and measured as the reduction in these losses to society. In addition, PWC use can negatively affect society in ways that are not directly related to the environment; therefore, the benefits of PWC restrictions must also include reductions in these nonenvironmental losses. Both broad categories of benefits—environmental and nonenvironmental—are discussed in more detail below.

### **B.1.1 Environmental Benefits**

The use of PWC may have adverse impacts on the aesthetic qualities of the park, on human health, and on the park's ecosystems. The benefits associated with avoiding these impacts are described below.

#### ***Aesthetic Benefits***

Among the largest and most directly damaging impacts associated with PWC use in national parks are its effects on the aesthetic qualities of park air and specifically the park soundscape. The natural soundscape is considered a natural resource of the park, and NPS attempts to prevent or minimize unnatural sounds that adversely affect the natural soundscape. National parks are especially valued for their pristine and undisturbed environments, which are often experienced by visitors through natural vistas and through the relative absence of visible or audible human activity (NPS, 2000b). The improvement or preservation of these aesthetic qualities, either in the form of reduced noise pollution or improved visibility, is therefore a potentially important source of benefits from reducing PWC use.

**Noise Reduction.** Perhaps the most noticeable and intrusive aspect of PWC is the level of sound they emit during normal operation. PWC have been measured to emit 65 to 105 decibels (dB) per unit, which may disturb visitors on the land and on the water. Noise limits established by NPS require vessels to operate at less than 82 dB at 82 feet (from the shoreline). The amount of noise from a PWC can vary considerably depending on its distance from another park visitor and whether it is in the water or in the air. Noise dissipates by 5 dBs for each doubling of distance from a 20-foot circle around the source and a PWC that is airborne is 15dBA louder than one that is in the water (Komanoff and Shaw, 2000). To put these noise-level estimates into perspective, Table B-1 also compares them with those of other familiar sounds.

PWC users tend to operate close to shore, to operate in confined areas, and to travel in groups, making noise more noticeable to other recreationists. Noise impacts from PWC use are caused by frequent changes in pitch and loudness due to rapid acceleration, deceleration, and change of direction. PWC noise intrudes in

**Table B-1. Comparative Noise Emissions**

Source	Decibel Level
Firearms	140
Motorcycle	90–110
Snowmobiles	73–100
Vacuum cleaner	70
PWC	65–105
Normal conversation	60
Normal breathing	10

otherwise quiet soundscapes, such as in secluded lakes, coves, river corridors, and backwater areas. Also, PWC use in areas where there are nonmotorized users (such as canoeists, sailors, and kayakers) causes conflicts between users.

Those who are most likely to benefit from reductions in PWC-related noise pollution in national parks are other park visitors and recreators, in particular those engaged in recreational activities that take place by the water, such as fishing, hiking, birdwatching, canoeing, kayaking, and swimming.

Several studies have shown that noise from motorized vehicles diminishes the recreational experience of other users. Several studies have found disamenities associated with various forms of mechanized recreational activities or other “technology-related” noises in recreation areas (Beal, 1994; Ivy, Stewart, and Lue, 1992; Bury and Luckenbach, 1983; Baldwin, 1970; Bury, Wendling, and McCool, 1976; Dunn, 1970; Lucas and Stankey, 1974; O’Riordan, 1977; Sheridan, 1979; Wagar, 1977).

Relatively few studies have specifically estimated the (negative) value of noise externalities on other recreators. One exception is a recent analysis conducted by the Federal Aviation Administration (FAA) to estimate the benefits of a regulation to restrict commercial air tours in Grand Canyon National Park (GRCA) (FAA, 2000). Using visitor-day value estimates from existing studies ranging from \$37 to \$92 (for backcountry, river, and other users of the park), the analysis assumed that these visitor-day values would be reduced in

relation to the how much aircraft noise interfered with the enjoyment of GRCA. Information about how aircraft noise affected different recreators was provided by a separate survey study of GRCA visitors. The survey found, for example, that for backcountry visitors 21 percent were “slightly” affected and 2.5 percent were “extremely” affected by the aircraft noise. In the FAA analysis, visitor value-days were assumed to be reduced by 20 to 80 percent depending on the percentage of respondents who indicated that their enjoyment of the park was “slightly,” “moderately,” “very,” or “extremely” affected by the noise.

Another example of such a study that focuses specifically on the noise impacts of PWC is one that has examined the losses that PWC users impose on other beach recreators (Komanoff and Shaw, 2000). This study assumed that an average beach day (per person) is worth between \$10 for a popular beach and \$30 for a secluded one and that each 10 dB increase in background noise decreases these values by 10 percent. The assumptions about the size of the decrease in value from increases in noise come from studies on the increased property values for houses in quiet neighborhoods. Assuming also that each 1 dB noise level increment reduces the value of a beach day by 1 percent, the study found that beachgoers suffer an average loss in recreation value of between \$0.50 and \$7.40 per jet ski cluster (1.6 jet skis over the course of a day) per person per day.

Other evidence regarding the noise-related losses imposed by PWC can be gleaned from studies that have examined the effects of congestion on recreation values. In these studies, congestion is often measured as the number of encounters with other recreators, which may be thought of as being roughly equivalent to hearing the sound of PWC. For example, in a study of backcountry recreators in the Caribou-Speckled Mountain Wilderness in Maine, Michael and Reiling (1997) found that weekend visitors experienced losses of \$22.3 (in 1990 dollars) per visit if they encountered more groups than expected.

**Visibility Improvements.** Several studies by the NPS and others have demonstrated the importance of visual air quality for visitors’ (and nonvisitors’) enjoyment and appreciation of national parks. Nevertheless, visual air quality has been and continues to be

threatened at many national parks across the country. Emissions from PWC in these parks are one of many potential (albeit, a relatively small) sources of these visibility impairments.

Although visibility effects can be characterized and measured in several different ways, “regional haze,” which uniformly reduces visual range and therefore impairs the appreciation of natural vistas, has been a particular source of concern. The primary contributors to regional haze and visibility impairments in general are small particles (particulate matter or PM) in the atmosphere that scatter and absorb light. There are several different sources and types of particles in the environment; however, sulfates (and to a lesser extent nitrates), primarily from the combustion of fuels, are the largest contributors to visibility reduction, especially in the eastern portions of the U.S. (Malm, 1999). Nationwide, the largest sources of sulfur dioxide emissions that contribute to sulfates in the atmosphere are power plants and other industrial sources. Mobile sources, such as cars, trucks, and buses (and PWC), account for the largest portion of NO<sub>x</sub> emissions, which contribute to nitrates.

Emissions factors per hour are not available for PWC but because PWC are powered by the same type (two-stroke) of engine as snowmobiles, snowmobile emissions factors may serve as a reasonable proxy. Table B-2 compares typical emissions rates for snowmobiles and other vehicles for NO<sub>x</sub> and PM. These are the pollutants that are the most likely contributors to visibility impairments from PWC emissions. These emissions rates vary greatly across types and uses of these vehicles; however, the table shows that PM emissions for snowmobiles are particularly high relative to automobiles. The California Air Resources Board found that a 7-hour ride on a PWC powered by a conventional two-stroke engine produces the same amount of smog-forming emissions as over 100,000 miles driven in a modern passenger car. It should also be noted, however, that automobiles account for a very small portion of PM emissions nationwide.

The estimates in Table B-2 suggest that PWC can be a source of visibility impairment in national parks, but their contribution to overall levels of regional haze in these areas is likely to be negligible. Nevertheless, in high-use areas and periods, they may negatively affect visual air quality in a noticeable way.



**Table B-2. Comparative Emissions Factors for Snowmobiles and Other Vehicles: NO<sub>x</sub> and PM**

	NO <sub>x</sub>	PM
Snowmobiles (lbs per 4 hr visit)	0.06	0.2
Automobiles (lbs per 4 hr drive <sup>a</sup> )	0.09–0.41	0.02
Diesel buses (lbs per 4 hr drive <sup>a</sup> )	3.22	0.26

<sup>a</sup>Assuming an average speed of 25 mph.

Source: National Park Service (NPS). February 2000a. *Air Quality Concerns Related to Snowmobile Usage in National Parks*. Denver, CO: National Park Service.

Several studies have investigated U.S. households' values for improvements in visibility at various national parks across the country. All of these studies have found a significant WTP by both users and nonusers for visibility improvements. One study in particular (Chestnut and Rowe, 1990) found that the average household in the southeast U.S. would be willing to pay \$68 (in 1999 dollars) per year for a doubling of the visual range in national parks in the southeast U.S.

### **Human Health Benefits**

In addition to NO<sub>x</sub>, ozone, and PM, PWC emissions typically contain a number of other pollutants, including CO, a conventional air pollutant that is commonly associated with mobile sources. It also includes a number of potentially toxic HC pollutants—benzene, 1,2-butadiene, formaldehyde, and acetaldehyde—and ammonia. As described in Table B-3, inhalation of these pollutants is associated with a wide variety of potential adverse health effects.

The extent to which the health effects listed in Table B-3 result from PWC emissions depends on the level and duration of exposure. Unfortunately, there is too little data and too much uncertainty to reliably estimate the incidence of these health effects. For comparative purposes, however, Table B-4 compares emissions rates of HCs and CO for snowmobiles (as in Table B-2, snowmobile emissions factors serve as a proxy for those of PWC) and for other vehicles.

**Table B-3. Health Effects Associated with Pollutants in PWC Emissions**

	Carcinogenic Effects	Other Chronic Health Effects	Acute Health Effects
Particulate matter (PM)	None	Chronic bronchitis	High-level exposure: mortality, acute bronchitis Low-level exposure: cough
Carbon monoxide (CO)	None	Aggravation of cardiovascular disease	High-level exposure: visual and mental impairment
Nitrogen oxides (NO <sub>x</sub> )	None	Reduced pulmonary function	High-level exposure: cough, fatigue, nausea Low-level exposure: lung irritation
Benzene	Known human carcinogen	Anemia and immunological disorders	High-level exposure: dizziness, headaches, tremors
1,3-Butadiene	Probable human carcinogen	Birth defects, kidney and liver disease	High-level exposure: neurological damage, nausea, headache Low-level exposure: eye, nose, throat irritation
Formaldehyde	Probable human carcinogen	NA	NA
Acetaldehyde	Possible human carcinogen	Anemia	High-level exposure: pulmonary edema, necrosis Low-level exposure: eye, skin, lung irritation
Ammonia	None	NA	High-level exposure: eye and lung irritation

NA = Not available

Sources: U.S. Environmental Protection Agency (EPA). Integrated Risk Information System.

<<http://www.epa.gov/ngispgm3/iris/index.htm>>. As obtained on October 15, 2000a.; U.S. Environmental Protection Agency (EPA). 1999a. *1997 National Air Quality: Status and Trends*. Washington, DC: Office of Air and Radiation.**Table B-4. Comparative Emissions Factors for Snowmobiles and Other Vehicles: HC and CO**

	HC	CO
Snowmobiles (lbs per 4 hr visit)	19.84	54.45
Automobiles (lbs per 4 hr drive <sup>a</sup> )	0.09–0.44	0.75–3.24
Diesel buses (lbs per 4 hr drive <sup>a</sup> )	1.23	4.45

<sup>a</sup>Assuming an average speed of 25 mph.Source: National Park Service (NPS). February 2000a. *Air Quality Concerns Related to Snowmobile Usage in National Parks*. Denver, CO: National Park Service.

The comparisons for CO are particularly relevant since highway vehicles account for over 50 percent of total CO emissions in the country (EPA, 2000b). Although the measures of vehicle use in the emissions factors are different across vehicles, the rates of HC and CO emissions for snowmobiles are distinctly higher than for automobiles and diesel buses. As a result, national park visitors recreating near areas where PWC use is permitted may be exposed to particularly high levels of CO and certain HCs.

Restrictions on PWC use in national parks could potentially reduce harmful exposures to park visitors and workers, particularly for individuals who spend extended periods in high-use areas. The benefits of these restrictions can be expressed as the value of reductions in the incidence (i.e., the number of cases avoided) of harmful health effects, in particular those effects described in Table B-3. As previously mentioned, the total number of avoided health effects is not known; however, using information from a recent EPA study of the benefits of air pollution regulations (EPA, 1997), Table B-5 provides a summary of “unit” values for selected health effects. Based on a review and synthesis of several health valuation studies, these values represent best estimates of individuals’ average WTP to avoid a single case of the health effect. In the absence of more complete information on the total health benefits of reducing PWC use, these values provide a rough sense of the magnitude and relative size of the benefits associated with avoiding specific health effects that may result from acute exposures.

**Table B-5. Unit Values for Selected Health Effects**

Health Effect	Unit Value (mean estimate) (1999\$) <sup>a</sup>
Acute bronchitis	\$57
Acute asthma	\$41
Acute respiratory symptoms	\$23
Shortness of breath (one day)	\$6.8

<sup>a</sup>All amounts inflated using the consumer price index available from the U.S. Bureau of Labor Statistics, 2000.

### **Ecosystem Protection Benefits**

To the extent that damages to park ecosystems occur, their cumulative effect is to reduce the “ecological services” that these systems provide to individuals and households across the country. National park ecosystems are particularly valued for their unique biological, cultural, and geological resources and the recreational and other services they provide. A vast majority of park visitors (i.e., users) experience and enjoy the natural systems of the park through a wide variety of recreational activities (wildlife viewing, hiking, fishing, as well as using PWC). However, even individuals who are not park visitors (i.e., nonusers) can benefit from the knowledge that park resources are being protected and preserved. These nonuse values can stem from the desire to ensure others’ enjoyment (both current and future generations) or from a sense that these resources have some intrinsic value. Evidence of such nonuse values for park protection is provided in studies that have documented significant WTP by nonusers for improved air quality at parks (e.g., Chestnut and Rowe, 1990) and, more generally, for the protection of unique species and ecosystems (see, for example, Pearce and Moran [1994] for a review of such studies). Restrictions on PWC use in national parks can therefore provide benefits to both users and nonusers in a number of ways by protecting the parks’ ecological resources.

#### **B.1.2 Nonenvironmental Benefits**

Restrictions on PWC use in national parks can also improve societal welfare in ways that are not directly related to environmental quality in and around the parks. These potential nonenvironmental benefits are described below.

### **Public Safety Benefits**

With the increase in PWC use in recent years has come an increased concern relating to the health and safety of operators, swimmers, snorkels, divers, and other boaters. A study conducted by the National Transportation Safety Board (NTSB) in 1998 revealed that although recreational boating fatalities have been declining, PWC related fatalities have increased in recent years (NTSB, 1998). PWC accident statistics provided by the U.S. Coast Guard supports the increase in PWC-related fatalities. Within the

U.S. five PWC-related fatalities occurred in 1987 and 68 PWC-related fatalities occurred in 2000. However, the peak occurred in 1997, with 84 PWC-related fatalities. Since 1997, PWC-related accidents, injuries, and fatalities have decreased. Following this same pattern, the percentage of PWC out of all boats involved in accidents have decreased from 36.3 percent in 1996 to 29.6 percent in 2000. The increases and decreases in PWC accidents, injuries, and fatalities are comparative to the number of PWC sales and number of PWC owned (Schmidt, 2001).

Restrictions on PWC use in national parks would certainly reduce the number of such incidents in the parks.<sup>1</sup> The primary beneficiaries would be the PWC users themselves, whose safety would be protected; however, these benefits may be implicitly accounted for in the consumer surplus changes (see Section B.2) that these recreators experience as a result of the restrictions.<sup>2</sup> Other summer recreators (non-PWC) might also benefit if they would otherwise be at risk of being involved in accidents with PWC. In addition, PWC accidents can impose costs on NPS and other local state and local government agencies that are responsible for providing medical, rescue, and related assistance. Reductions in PWC accidents in national parks would therefore allow some of the resources devoted to these activities to be diverted to other publicly beneficial uses.

### ***Avoided Infrastructure Costs***

Allowing PWC in national parks requires NPS to develop, maintain, and operate an infrastructure to support these activities. In particular launch sites and buoys must be designated, maintained, and monitored. The costs associated with these activities vary widely across parks, depending on the physical characteristics of the parks and the level of PWC use permitted.

By restricting PWC use, some of these infrastructure-related costs can be avoided or reduced. As a result some of the resources

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<sup>1</sup>The benefits of these reductions may be offset to some degree by increased PWC usage and accidents in areas outside the parks.

<sup>2</sup>To the extent that PWC users are aware of the safety risks they face, the potential losses to themselves from accidents should already be factored into their consumer surplus from using a PWC. This implies that the safety benefits to these individuals from reducing PWC use are implicitly accounted for (i.e., deducted from) the consumer surplus losses to these recreators.

devoted to these activities can also be diverted to other publicly beneficial uses.

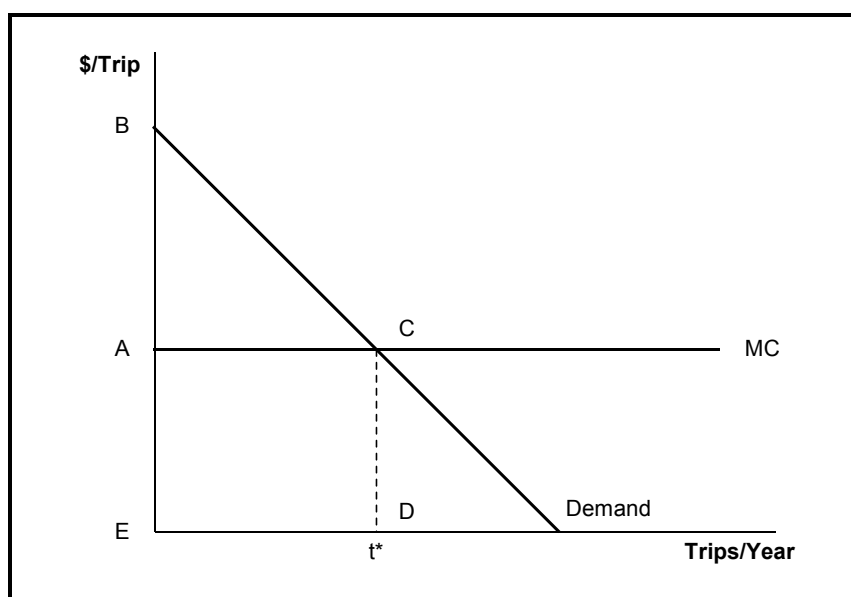
## B.2 SOCIAL COSTS OF PWC RESTRICTIONS

The primary losses associated with PWC use restrictions in national parks will accrue to

- PWC users, in particular individuals who will not PWC in the park as a direct result of the restrictions, and
- providers of PWC-related services for park visitors.

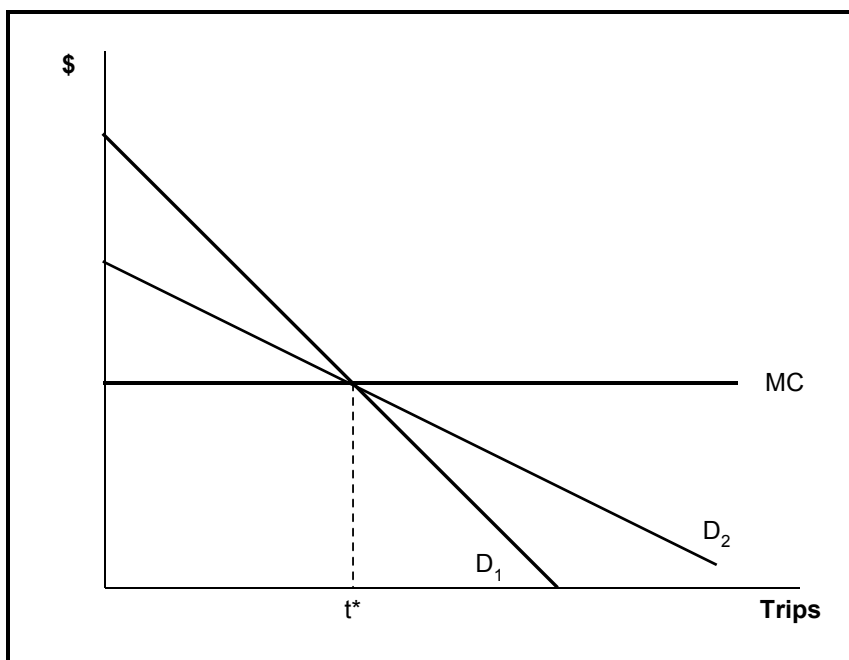
The welfare losses to individual consumers (PWC riders) are measured by their loss in consumer surplus. Consumer surplus is measured as the difference between the total cost of a product or activity to the consumer and the total amount the individual would be willing to pay for that activity. In the context of recreation activities, Figure B-1 depicts an individual demand curve for PWC trips, the marginal cost of a trip (MC, assumed to be constant), and the optimal number of trips per year,  $t^*$ . The triangle ABC measures the consumer surplus associated with this optimal number of trips—the difference between what the individual paid for the trips, ACDE, and the total WTP for the trips (the area underneath the demand curve), EBCD.

**Figure B-1. Consumer Surplus**



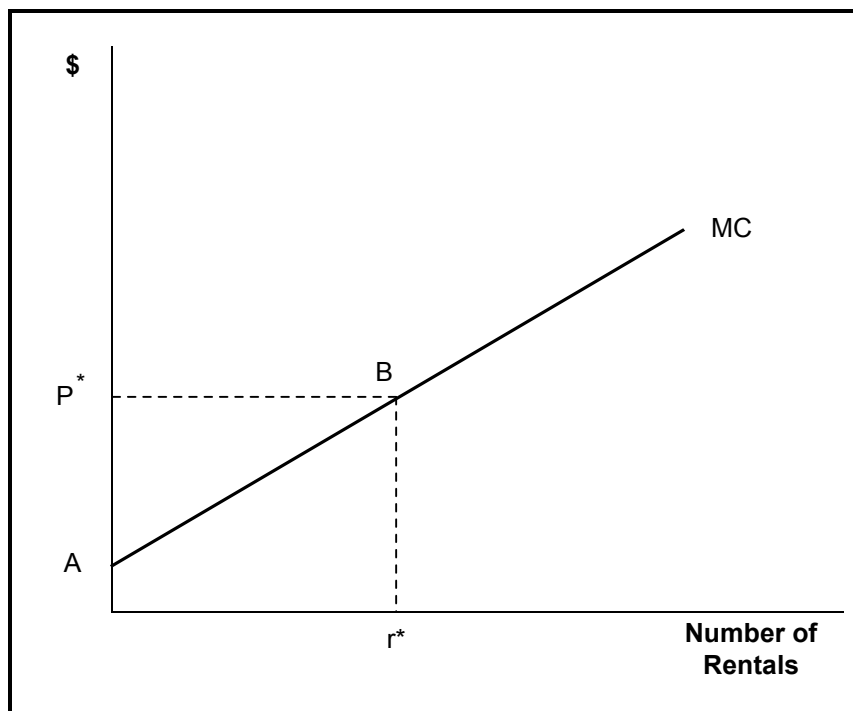
The extent of the welfare loss to an individual rider depends crucially on the availability of substitute activities. Figure B-2 depicts two alternative demand curves for PWC trips to a particular waterbody. The slope of the demand curve reflects the number of substitute activities available to a particular individual and the preferences of that individual toward those substitutes. The flatter demand curve,  $D_2$ , indicates that this individual has a variety of close substitutes for PWC use in this area (these substitutes could include PWC riding in a different area or participating in a different activity such as motorboating). The individual with the steeper demand curve,  $D_1$ , has fewer substitute activities he/she enjoys as much as using his/her PWC in this waterbody. If both individuals choose the same number of trips, as in Figure B-2, the person with the steeper demand curve,  $D_1$  (fewer substitutes for PWC use) receives greater consumer surplus from use in this particular waterbody and thus will experience a greater loss in welfare if the waterbody is closed.

**Figure B-2. Consumer Surplus and Substitute Activities**



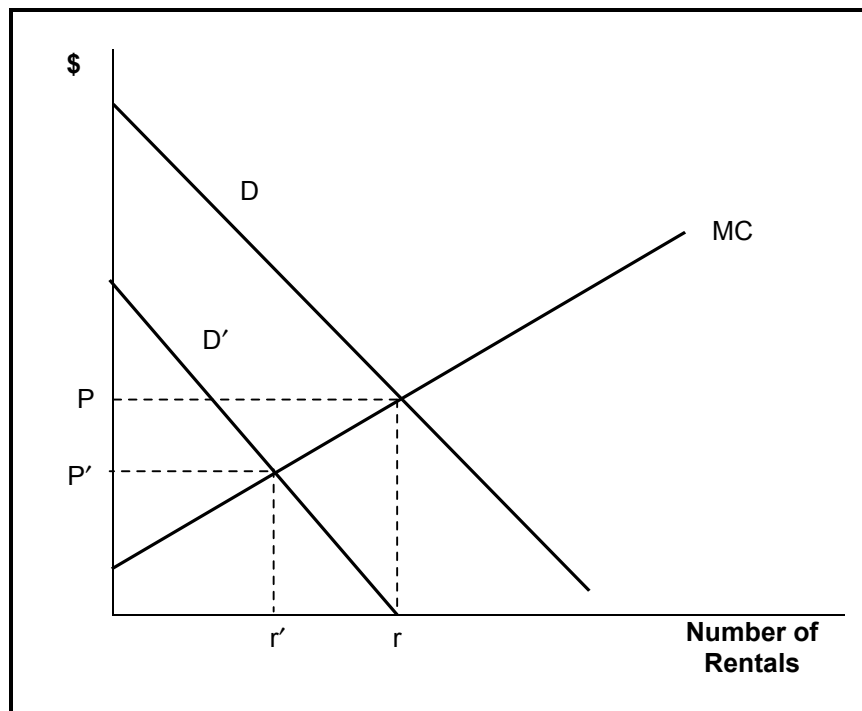
The change in welfare for businesses is measured by producer surplus, or the area  $AP^*B$  in Figure B-3, where  $P^*$  is the market price of the good, for example a PWC rental. Producer surplus measures the difference between total revenue and variable costs. If the firms face an upward-sloping marginal variable cost (MC) curve, then a decrease in demand, indicated in Figure B-4 from  $D$  to  $D'$  will result in a lower producer surplus for PWC rental companies.

**Figure B-3. Producer Surplus**





**Figure B-4. Producer Surplus and a Change in Demand**



If PWC riding decreases as a result of the regulation, then the suppliers of PWC and other tourism-related services will be affected, including rentals and sales of PWC and PWC accessories, lodging, meals, and other tourism-related expenditures. If demand for other types of recreation related rentals increases, then some businesses may experience an offsetting increase in producer surplus.